

THE DELAWARE ESTUARY

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A MANAGEMENT PLAN FOR
THE DELAWARE ESTUARY

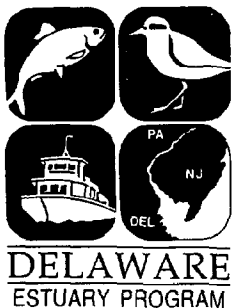
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Comprehensive Conservation and Management Plan for the Delaware Estuary, Public Review Draft, December 1994

The Comprehensive Conservation and Management Plan for the Delaware Estuary was prepared under the Water Quality Act Amendments of 1987, Section 320, The National Estuary Program. For further information, contact the Delaware Estuary Program at 1-800-445-4935.



DELAWARE ESTUARY PROGRAM

c/o United States Environmental Protection Agency
841 Chestnut Building
Philadelphia, Pennsylvania 19107

January, 1995

From the Policy Committee

We are pleased to provide you with a copy of the Delaware Estuary Program's Draft Comprehensive Conservation and Management Plan for your review and comment. This document is intended to communicate our understanding of the health of the Estuary, to increase public involvement in Delaware Estuary Program activities and to build consensus on a broad array of actions that can be taken to improve water quality and enhance the living resources of the Estuary.

By design, the Delaware Estuary Program has involved hundreds of people in the development of this draft Plan through its committees, public meetings, workshops, and seminars. The Program has come a long way in the developing a body of scientific and technical data and information on which to base the draft Plan and in building public support for efforts to protect the Estuary. But the greatest challenge-- revising the Plan to reflect the concerns and comments of the public at large and implementation of the Plan's land management, water use, habitat protection, toxics, and education actions-- is ahead.

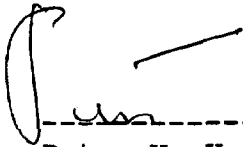
We invite you to read the draft Plan and to participate in the nine public meetings scheduled for March 1995. The Program recognizes that not all actions proposed in this draft are of equal importance in their ability to influence environmental quality and solve priority problems. Accordingly, we are particularly interested in your comments concerning the "value added" of specific actions and the relative priority among actions.

Please submit your comments to Robert Tudor, Program Coordinator, Delaware Estuary Program, c/o EPA Region III, (3ES41), 841 Chestnut Building, Philadelphia, PA 19107 no later than April 14, 1995 or bring them to one of several public meetings we are planning for March. These meetings will be announced in our newsletter and other media. You can also call 1-800-445-4935 for further information or to receive the newsletter.

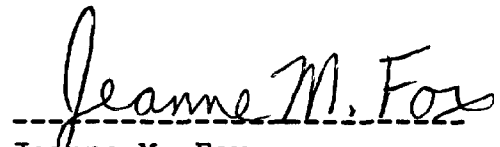
Lastly, your comments are important to us. We thank you in advance for your interest and input.

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DELAWARE ESTUARY PROGRAM
POLICY COMMITTEE



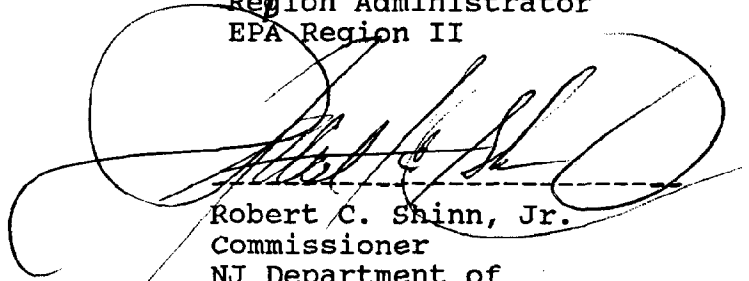
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Delaware Estuary *Vision* 2020

In the 1980s, many of us in the Delaware Estuary region became even more concerned about the state of the environment in this place we call home. We wanted unpolluted water for the recreational activities so abundant in our region. We needed an adequate supply of clean water to drink, and we were concerned about the effects of air and water pollution on our health. We thought the land should be developed in a sustainable manner which would protect our natural resources as well as support a viable economic base.

Out of our concerns came the nomination of the Delaware Estuary for inclusion in the National Estuary Program. The Estuary was accepted and awarded national significance status in 1988. Since that time we, as concerned citizens, have worked diligently to develop a Comprehensive Plan to protect and enhance the natural resources of the Delaware Estuary.

Our vision of the region — twenty-five years from now — guided formation of the goals put forth in the Plan. Our vision will be realized as we work to achieve these goals. We envision:

Environmental and economic improvements, brought about by the cooperative efforts of private citizens, industry, environmentalists, and local, state, and federal governments;

An adequate water supply for the 21st century and beyond, with improved water quality conditions for all living things and sustainable use of aquatic resources;

A watershed approach to management that values interconnected habitats, preserved land, and planned efforts to protect and enhance the Estuary's natural resources, while maintaining the economic viability of the region;

Increased public education and involvement through timely, accurate, and accessible information provided to the public regarding all known and planned activities that may significantly affect the watershed;

An expanded number of public access points within the Estuary watershed and increased, but ecologically responsible, use of these public access facilities.

The Plan is a blueprint for building our vision. The proposed steps, however, will require the foresight and leadership of the Estuary's residents to make the vision a reality. If we, as individuals, take pride in the Delaware Estuary and feel a sense of ownership towards it, we can effect important changes.

This is our pledge to the Estuary and to its citizens. We invite those who read this document, who live, work, or play in the Delaware Estuary, to take this pledge and to consider it a vital part of their daily lives:

....We the people of the Delaware Estuary watershed recognize its importance, and our linkage to it. We are committed to do our part to protect and enhance it. Our primary relationship to the Delaware is one of stewardship. We know what and where our most sensitive environmental resources are, and we will honor and protect them. The diversity and abundance of plants and animals throughout the Delaware Estuary are of great importance and value to us. We support actions to establish a fair and honest balance between the needs of recreational and commercial fisheries and a sustainable fish and shellfish level. We exhort our local, state, federal, and private entities to develop workable, integrated, regional watershed approaches to protect habitat, ensure good water quality, and manage land use including sound port management and economic development consistent with the environmental needs of the Delaware Estuary.

The health and potential of the Delaware Estuary is a direct result of our everyday activities. Education and involvement will be the cornerstone of improvements that occur in this region. As a tool to begin that education, this Plan recommends the way in which improvements to the Estuary can be achieved through actions at various levels. Through these actions, we, as a region, can begin the process for achieving a sustainable society for future generations. ***We invite you to become a participant in helping us make this vision a reality.***

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LIST OF ACRONYMS

ANJEC	Association of New Jersey Environmental Commissions
ASCS	Agricultural Stabilization and Conservation Service
ASMFC	Atlantic States Marine Fisheries Commission
AVHRR	Advanced Very High Resolution Radiometer (USFS)
BMP	Best Management Practice
CAC	Citizens Advisory Committee
CCMP	Comprehensive Conservation and Management Plan
CCMUA	Camden County Municipal Utilities Authority
CSO	Combined Sewer Overflows
CZARA	Coastal Zone Act Reauthorization Amendments
CZMP	Coastal Zone Management Program
DDX	Shorthand for DDT and its metabolites DDD and DDE
DE	State of Delaware
DEDHSS	Delaware Department of Health and Social Services
DELCORA	Delaware County Regional Authority
DELEP	Delaware Estuary Program
DELTOX	Delaware Estuary Toxics Model
DEM	Dynamic Estuary Model
DFW	Department of Fish and Wildlife
DNREC	Delaware Department of Natural Resources and Environmental Control



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DBRC	Delaware Bay and River Cooperative
DRBC	Delaware River Basin Commission
DRBFWMC	Delaware River Basin Fish and Wildlife Management Cooperative
DVRPC	Delaware Valley Regional Planning Commission
EIS	Environmental Impact Statement
EMAP	Environmental Monitoring and Assessment Program
FDA	U.S. Food and Drug Administration
GIS	Geographic Information System
IRP	Integrated Resource Planning
ISTEA	Intermodal Surface Transportation Efficiency Act
LA	Load Allocation
MAFMC	Mid-Atlantic Fishery Management Council
MOU	Memorandum of Understanding
MSRC	Marine Spill Response Corporation
MSX	"Multinucleated sphere X unknown"
NEPA	National Environmental Policy Act
NJ	State of New Jersey
NJDEP	New Jersey Department of Environmental Protection
NJDFGW	New Jersey Department of Fish, Game and Wildlife
NJDOH	New Jersey Department of Health
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System

ACRONYMS

NPS	Nonpoint Source
OMWM	Open Marsh Water Management
ODES	Ocean Data Evaluation System
PA	State of Pennsylvania
PADCA	Pennsylvania Department of Community Affairs
PADER	Pennsylvania Department of Environmental Resources
PADH	Pennsylvania Department of Health
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCMP	Preliminary Conservation and Management Plan
PEC	Pennsylvania Environmental Council
POTW	Publicly Owned Treatment Works
PPTF	Public Participation Task Force
PRM	Potomac Raritan-Magothy
PSE&G	Public Service Electric and Gas
RIMS	Regional Information Management Service
SCS	Soil Conservation Service
SEP	Supplemental Environmental Projects
TDR	Transfer of Development Rights
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TRACS	Transport Release Automated Cargo Status
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard



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USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WLA	Waste Load Allocation
WQC	Water Quality Criteria

CHAPTER I: INTRODUCTION

Wise conservation and management of the Delaware Estuary is arguably the most important cooperative environmental initiative ever jointly undertaken by the States of New Jersey, Pennsylvania, and Delaware. While much has been accomplished over the past few decades to improve water quality and provide adequate supplies of water to the people who live, work, and play in the Delaware Estuary watershed, much remains to be done. The Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development. Addressing these threats presents both challenges and opportunities, and will require a multi-state effort, participation by all levels of government, and citizen support and commitment to the stewardship of the Estuary. The Delaware Estuary Program is dedicated to facilitating these efforts.

The Estuary is faced with continuing threats from toxic substances, habitat loss and fragmentation, and human development.

In the past few years there has been a dramatic shift in the way people throughout the world think about their environment. Publication of the first color photograph of Earth from space provided a dramatic picture of a small blue planet and heightened international awareness of the vulnerability of its natural resources and the need for careful stewardship of those resources. An increased awareness and understanding of global environmental problems — resource depletion, loss of biological diversity, toxics contamination, and sea level rise — have forced us to acknowledge that our collective actions threaten ecological systems.

These emerging problems have also forced us to re-evaluate our management of ecological systems. We now understand that regionwide management approaches, those that emphasize integrated strategies across political boundaries, offer the greatest potential for effective restoration and protection of ecosystems and protection of human health. We realize that in addition to targeting the protection of specific resources, such as air, land, or water, it is necessary to take a broader approach and protect the systems of which those resources are interdependent parts.

The approach embodied in this Plan couples this global perspective and watershed management approach to address environmental and economic issues that are specific to the Delaware Estuary. This approach does not result in a new centralized program that



Figure 1. A Satellite Image of the Delaware Estuary Watershed, Earth Satellite Corporation, 1994.

competes with or replaces existing programs; rather it provides a framework and new focus for effective integration of ongoing management activities.

The emerging global public consciousness has also produced a conservation ethic — we recognize the folly of resource consumption without active replenishment and recycling efforts. This ethic will require a societal reshaping of the relationship between economics and the environment in "sustainable development" terms, rather than in terms of "environment versus development". Sustainable development, according to the United Nation's World Commission on Environment and Development, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This means improving the quality of human life, while living within the carrying capacity of supportive ecosystems.

Until recently, resource protection often focused on saving a single animal or plant species, or a single river, in a specific place. We now realize that while individual species and resources are important, their role as a part of an ecosystem is what determines their value. We must preserve the integrity of the system. This evolution toward the preservation of ecological systems, as a primary conservation ethic, is driving a parallel philosophy of sustainable development: how can we nurture vibrant, healthy, and equitable communities that can be sustained by natural resources and systems without destroying or degrading them and compromising quality of life in the future?

Fundamental tenets of sustainable development include:



A long-term perspective for planning and policy development that harmonizes public and private, environment and development, and community and regional interests.



Integration of environmental (health and ecosystem) protection and economic development in policy and decision-making at all levels.



Intra- and intergenerational equity, supporting environmental justice for people living now, equity for future generations, and consideration of cultural heritage.

Sustainable development, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".



The Delaware Estuary Program, as an advocate of sustainable development, will take responsibility to: 1) provide for widespread participation in decisions that affect the Estuary; 2) develop and clearly articulate programs and actions that will be mutually beneficial to both the economy and the environment of the watershed; 3) forge partnerships with industry, commerce, and local governments in pursuit of the economic viability of the region and an improved quality of life; and 4) enhance and preserve the Estuary's living and natural resources. We recognize that public involvement and education are the cornerstones of resource protection and sustainable development in the Delaware Estuary watershed. Our recommendations in this Plan, no matter how extensive and farsighted, will not succeed unless they and their rationale capture the imagination, attention, and concern of the public at large.

Public involvement and education are the cornerstones of resource protection and sustainable development in the Delaware Estuary watershed.

A. The Delaware Estuary

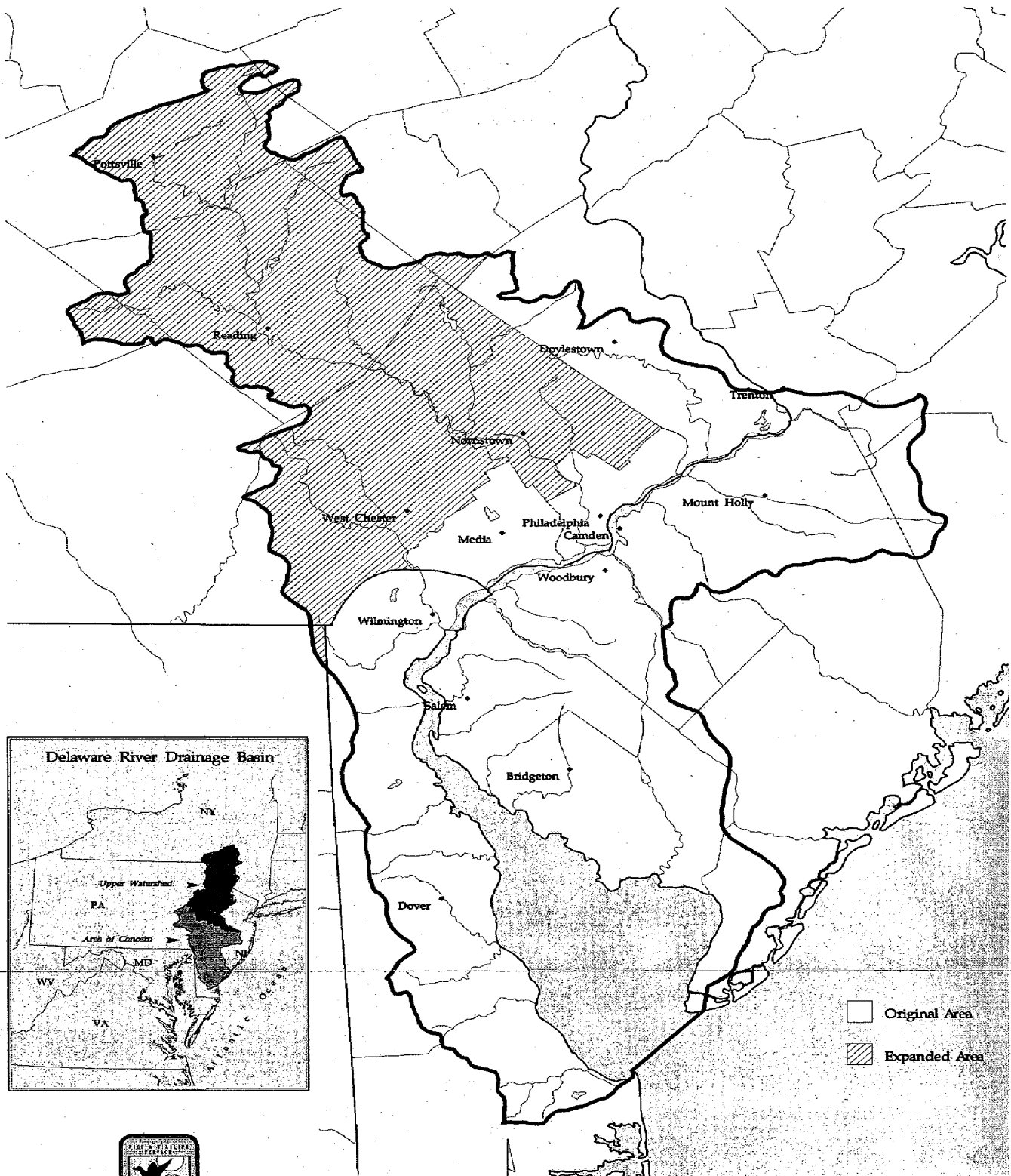
All of us are connected to the Delaware Estuary, whether we live in Philadelphia; far upstream in Hancock, New York; or right on the Bay at Cape May, New Jersey; or Lewes, Delaware. We live in the Delaware Estuary's watershed.

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity and complex water movements affected by ocean tides and river currents. They are also highly productive ecosystems with a range of habitats for many different species of plants and animals.

A watershed is an area of land drained by a river or other body of water. The water that flows over the land surface, usually from rain, is called runoff. There are small watersheds, which receive runoff from a few acres into a creek, and large watersheds, which drain larger areas into a river. A large watershed is made up of many smaller ones, just as a large river is fed by many small tributaries.

The Delaware River Basin is a large watershed which encompasses all of the land that flows to the Delaware River and Bay. It stretches from Delaware County, New York, south to Cape May, New Jersey and Cape Henlopen, Delaware. The lower half of the Basin, from Trenton, New Jersey and Morrisville, Pennsylvania, south to the Jersey and Delaware capes, constitutes the Delaware Estuary Program area of concern. This

Area of Concern of the Delaware Estuary Program

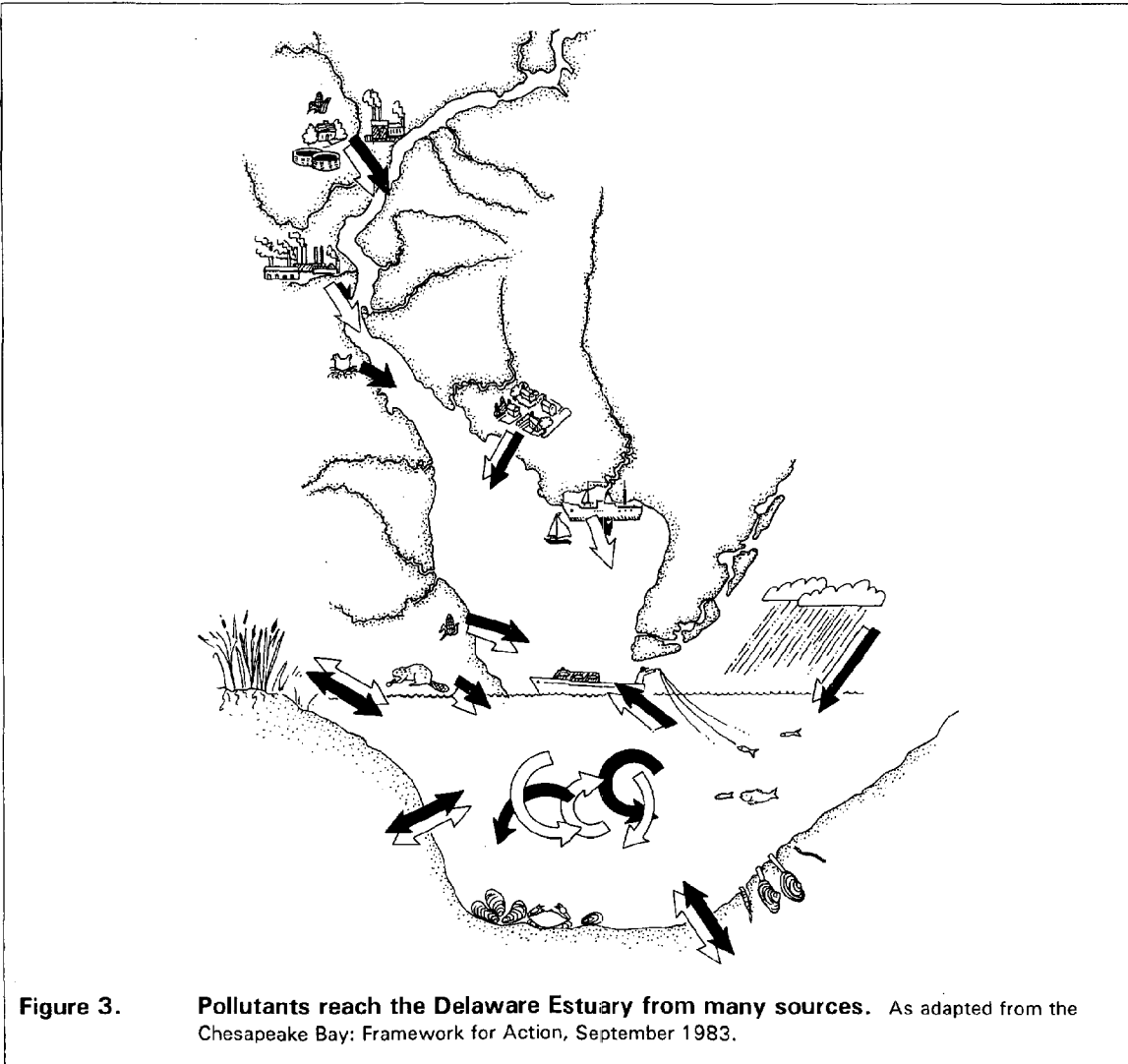


Prepared by the Delaware Bay Estuary Project, USFWS
 Universal Transverse Mercator Projection, Zone 18, NAD 1927
 November 1994

Figure 2. Area of Concern of the Delaware Estuary Program

region includes all of the territory in three states that drains into the Estuary, including the 13 counties that border the Estuary and the outlying counties that drain into its tributaries (See Figure 2 for a depiction of the basin, the watershed, and the Estuary).

As rainwater moves over the land in this watershed, it carries with it many potential pollutants which will eventually end up in the Delaware Estuary — including oil dumped down a storm drain in Reading, Pennsylvania; pesticides from a New Jersey farm field; fertilizer from a lawn in Chester, Pennsylvania; hydrocarbons (oil and gasoline) from highway runoff in Trenton, New Jersey; sewage from a failed septic tank in Lewes, Delaware; or sediment from a construction project in Port Jervis, New York. So even if you do not live near the Delaware Estuary, your actions most





definitely have an impact on it. Through the liquid web of flowing water we are all connected to the Estuary.

Estuaries have economic, recreational, and aesthetic values. People love water sports and visit estuaries to boat, fish, swim, and just enjoy their beauty. Estuaries often have ports serving shipping, transportation, and industry. The relationship among plants, animals, and people makes up the estuarine ecosystem. When its components are in balance, plant and animal life flourish.

Because of our love of the water, almost half of the United States population now lives in coastal areas, including along the shores of estuaries. This population trend is accelerating; coastal counties are growing three times faster than anywhere else in the Nation. The Delaware Estuary watershed experienced a significant population increase in the last decade (See Figure 4) and may reach an additional 777,000 people by the year 2020 (Seymour, 1994). Unfortunately, this increasing concentration of people upsets the balance of estuarine ecosystems. People need housing, services, and roads, so new industry and businesses arrive to provide them. In addition, the removal of natural vegetation and trees for development can cause soil erosion and destroy natural habitats, contributing to the extinction of endangered wildlife. When severe, such stresses have led to public health threats, forcing government authorities to close beaches and shellfish beds and issue warnings about eating fish.

B. Historical Overview of the Delaware Estuary Watershed

The abundant natural resources that make the Delaware an estuary of national and international importance today have sustained human populations for thousands of years. In determining how to protect those resources for the future, it is important to be aware of the evolution of the relationship between people, the landscape of the watershed, and the Estuary.

The first humans probably arrived on the shores of the Delaware Estuary about 12,000 to 13,000 years ago and used the Delaware River and Bay for food, transportation, and trade. The population of these settlers was never large enough to have a significant impact on the environment; however, they did clear some land for agriculture, starting about 3,000 years ago, and they burned

PERCENT CHANGE IN POPULATION, 1970-1990
Delaware Estuary Watershed Communities

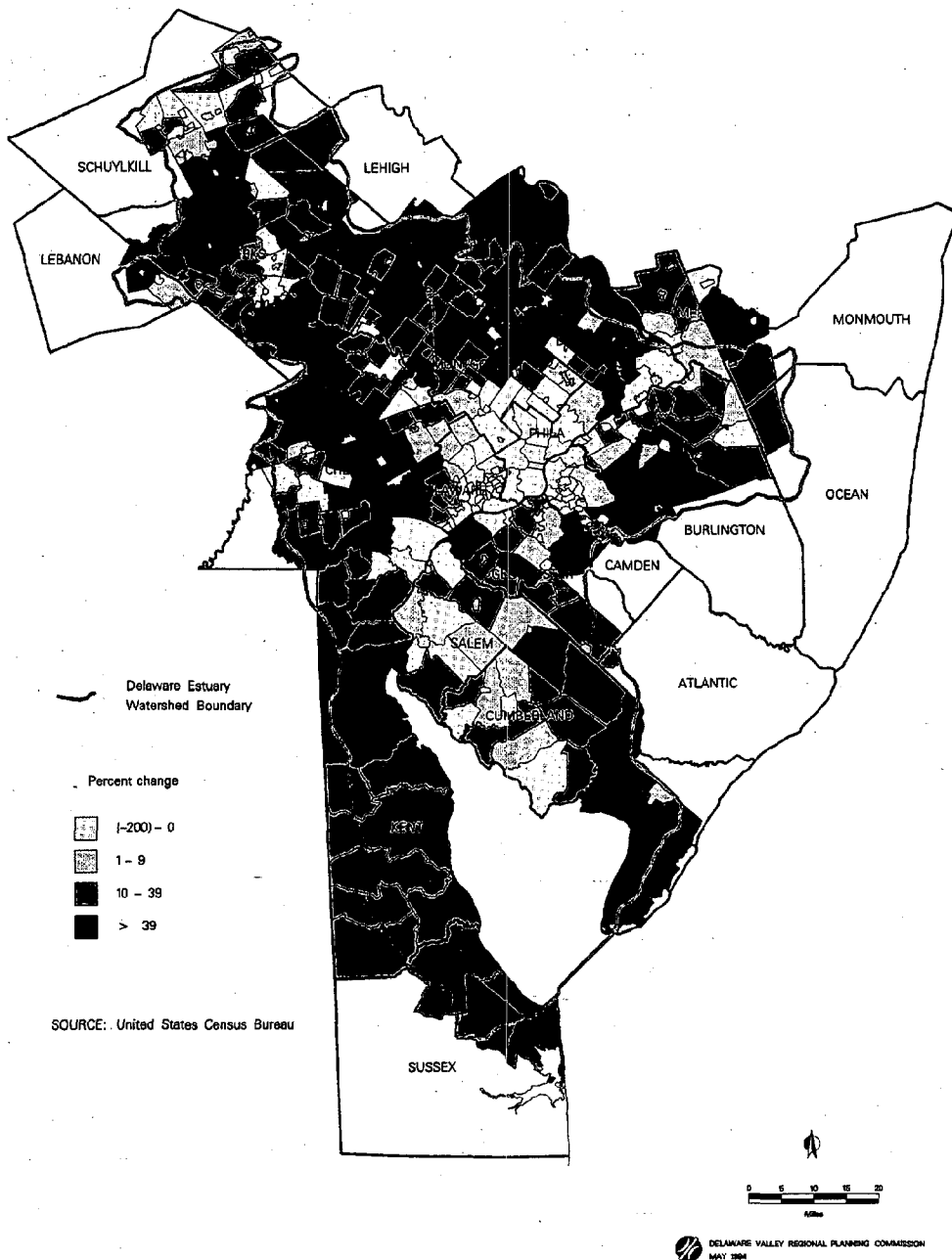


Figure 4. Percent Change in Population, 1970-1990.

forested land to improve habitat for white-tailed deer and other game (Berger *et al.*, 1994).

Europeans established a presence in the Estuary region in the first quarter of the 17th century. The Dutch and Swedes each controlled the region for periods of time, but, by the 1660s, the English were in complete control, having established a variety of small settlements. Major alterations in the Delaware Estuary environment began during this time.

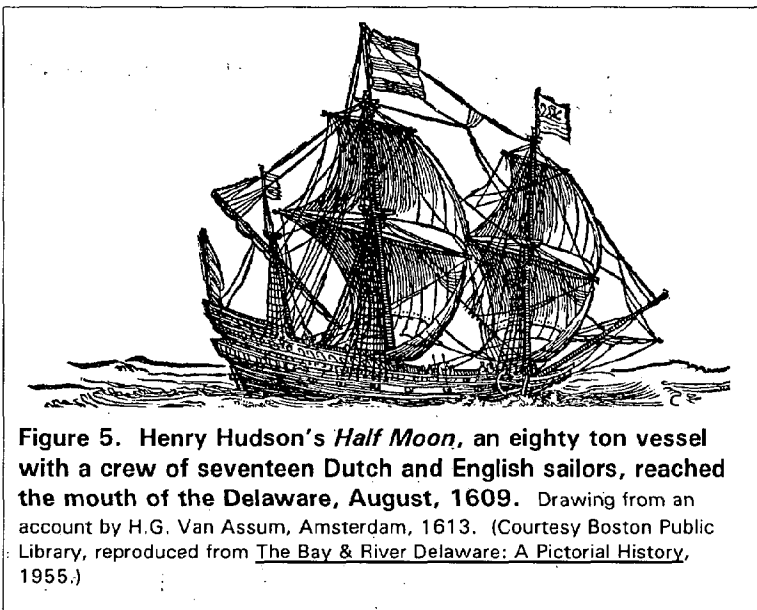


Figure 5. Henry Hudson's *Half Moon*, an eighty ton vessel with a crew of seventeen Dutch and English sailors, reached the mouth of the Delaware, August, 1609. Drawing from an account by H.G. Van Assum, Amsterdam, 1613. (Courtesy Boston Public Library, reproduced from *The Bay & River Delaware: A Pictorial History*, 1955.)

In 1682, Philadelphia was founded by an English Quaker, William Penn; by 1700, it had 5,000 inhabitants. Penn's settlement grew to become America's pre-eminent city and port. The growth of agriculture was largely responsible for Philadelphia's dominance as a commercial center, in the early 18th century, and for the accelerated transformation of the Delaware Estuary watershed from a wilderness to a pastoral landscape.

Large forested areas were cleared, resulting in erosion and losses of topsoil. These soils altered the topography of the Estuary. Shoreline dredging, diking, and filling began during this period, resulting in loss of extensive areas of tidal marsh and natural shoreline, especially north of Wilmington.



Figure 6. George Heap drew this well known view of Philadelphia about 1753. (Courtesy of New York Public Library, Stokes Collection, reproduced from *The Bay & River Delaware: A Pictorial History*, 1955.)

In 1769, a visiting Englishman commented on the "mess" in the Philadelphia harbor on the Delaware River. The "mess" grew, and, in 1799, the Estuary's first official pollution survey noted contamination entering the river from ships, sewers, and polluted wetlands. By the 1840s, the deepwater ports of the Estuary had become manufacturing centers, and the railroad had transformed villages in South Jersey into regional centers for agriculture.

By the end of the 19th century, increased population and industrialization had transformed much of the upper Estuary watershed. Fisheries were declining, due at least in part to overfishing and pollution. In many places, drinking water supplies were contaminated, and pollution — primarily sewage — caused outbreaks of typhoid and other diseases in urban areas.

Railroads, streetcar lines, and new roads enabled people to live inland, away from waterborne transportation and colonial cities and towns, which usually were established on waterways. The industrialization of the waterfront and water pollution led to a dramatic decrease in the recreational use of the Delaware, particularly in urban areas. The Estuary became less of a regional focal point as fewer people had direct contact with it.

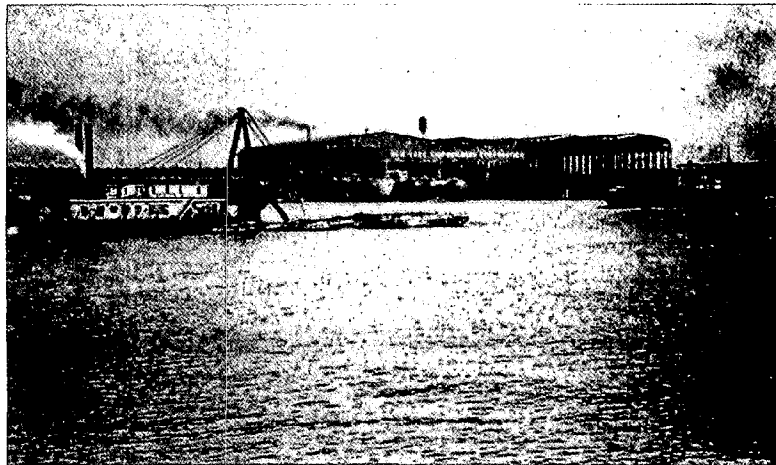


Figure 7. Dredges and shipyards have been prime factors in making the Delaware a great river. (Courtesy of Commercial Museum, Philadelphia. Reproduced from *The Bay & River Delaware: A Pictorial History*, 1955.)

By the 1940s, anadromous fish such as shad and herring, already depleted by overfishing, were unable to migrate through a low oxygen barrier in the Philadelphia area to upriver spawning grounds. This problem, combined with small dam construction on sub-tributaries and industrial water diversion, nearly destroyed the fisheries. Water quality concerns were voiced; however, the importance of the World War II effort overshadowed these environmental concerns. During this period of time there was a



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large increase in pollution of the Delaware Estuary resulting from defense-related industries (Albert 1988).

By 1950, the urban reach of the Delaware was one of the most polluted stretches of river in the world, and serious cleanup efforts were initiated. A major criterion for cleanup and indicator of success was the level of dissolved oxygen in the water. In the 1950s, the Philadelphia region of the river had essentially zero oxygen during most of the warmer months of the year.

Throughout the 1960s and 1970s, increased state, interstate, federal, and public interest in pollution control, and the passage of the 1972 Clean Water Act, led to dramatic improvements in the Estuary's water quality. The Delaware River Basin Commission (DRBC) adopted a waste load allocation program in 1967 and, together with state and federal agencies, started discussions on pollution abatement programs. Industries were successful in reducing pollution in the 1960s and 1970s, followed by municipal sewage treatment successes in the 1970s and 1980s. By the end of the 1980s, over \$1.5 billion had been spent by the public sector on the construction of new, and the improvement of old, sewer facilities on the Delaware between Trenton and Wilmington. Countless billions were spent by the private sector during the same period.

Today, the Estuary is certainly not pristine, but it is much cleaner than at any prior time in this century. Over 90 percent of the Estuary meets the swimmable and fishable goals of the Clean Water Act. Recreational use is returning to the tidal river. Greenway trails are being established, linking historic sites, wildlife areas, and recreational facilities. Public access to the Estuary has increased as the result of a variety of new public parks in all three states.

The economic importance of the Estuary is also growing. New forms of shipping have reinvigorated Estuary ports, and new industrial and commercial uses are again bringing life to urban waterfronts. From Bristol to Camden to New Castle, the Estuary is a focal point for tourism.

Still major problems remain.



Although there have been dramatic improvements in the water quality in the River, water quality problems still exist. In particular, water quality does not meet

By 1950, the urban reach of the Delaware was one of the most polluted stretches of river in the world, and serious cleanup efforts were initiated.

the standard for swimming in the Philadelphia and Camden sections of the River, due to bacteria. Also, while the level of dissolved oxygen usually meets the current standard established for the Delaware River, the dissolved oxygen standard would have to be raised to allow maintenance and propagation of resident fish and other aquatic life.



The Delaware Estuary's fisheries have exhibited a general downward trend since 1900. Evidence suggests that overfishing throughout the mid-Atlantic region, along with habitat destruction and overall water quality conditions, are responsible for this decline. In recent years, certain anadromous fish species including shad, Atlantic sturgeon, and striped bass have increased in numbers because of water quality improvements and harvest restrictions, but abundances of these and other species have not reached historic levels because of habitat perturbations and lack of coordinated management plans. In addition, populations of estuarine dependent species, specifically summer flounder and weakfish, have declined in recent years. Causes include bycatch outside of the Estuary, impingement and entrainment, overfishing, and lack of coordinated management.



Heavy use of surface and groundwater threatens the long-term water supply for industrial and domestic use and for maintenance of habitats and living resources. Depletive water uses are of particular concern in relation to maintaining protective salinity levels for drinking water in the Delaware Estuary.



Elevated levels of toxic substances have been detected in sediment, the water column, and in tissues of organisms dependent on the Estuary. Fish consumption advisories occur in all three states.



A significant area of the Estuary, from the vicinity of the C&D Canal northward to Trenton, New Jersey, has a degraded river bottom biological community. This degradation is a concern since benthic organisms are a major link in the food chain to fish, shellfish, birds, and wildlife.



Habitat fragmentation and alteration continue to stress ecosystem integrity, affecting the survival and reproductive success of living resources dependent on specific habitat types and impairing the system's ability to buffer pollutant impacts. In particular, loss of freshwater wetlands continues in some areas of the Estuary watershed.



The current pattern of land development consumes large amounts of natural habitat and agricultural land, and results in fragmentation of habitat, with adverse impacts on living resources and water quality.

C. Role of the Delaware Estuary Program

Because of its importance as a natural resource, the intensity of human activities within its watershed, and the breadth and complexity of its issues, the Delaware Estuary was nominated by the three state Governors for inclusion in the National Estuary Program in 1988. A Management Conference was officially convened in July 1989, and five goals were established:

Delaware Estuary Program Goals

Provide for the restoration of living resources of the Delaware Estuary and protect their habitats and ecological relationships for future generations;

Reduce and control point and nonpoint sources of pollution, particularly toxic pollution and nutrient enrichment, to attain the water quality conditions necessary to support abundant and diverse living resources in the Delaware Estuary;

Manage water allocations within the Estuary to protect public water supplies and maintain ecological conditions in the Estuary for living resources;

Manage the economic growth of the Estuary in accordance with the goal of restoring and protecting the living resources of the Estuary; and

Promote greater public understanding of the Delaware Estuary and greater participation in decisions and programs affecting the Estuary.

The Delaware Estuary Management Conference consists of six committees and hundreds of people, representing a wide range of interests and expertise. Since 1989, all the committees have been

actively engaged in a process, focused on development and implementation of a Comprehensive Conservation and Management Plan (CCMP) for the Estuary. (See Appendix C for a list of committee members).

This draft Plan, which establishes a guide for action to achieve the goals, is the product of that effort. The various strategies and actions which collectively constitute this Plan reflect detailed study, careful deliberation, and aggressive consensus building. In formulating these strategies, an overt attempt was made to more efficiently allocate conservation and management resources and to avoid new centralized programs that would compete with or replace existing programs.

In general, this draft Plan establishes the following roles for the Delaware Estuary Program over the next 20 to 30 years:



A **facilitator** for other existing organizations; one who can bring people to the table and push for teamwork to resolve issues; not a regulator.



A **provider of information** to state and local decision-makers; information will include the benefits of taking appropriate actions, data and projections for critical areas, and reports on implementation progress.



A **leader** in defining terms such as sustainable development; providing a watershed focus; and working with local communities to approach issues from a regional perspective.



A **provider of incentives** to citizens, agencies, and organizations throughout the region for taking appropriate actions.

The Management Conference carefully considered each of these roles in crafting this Plan.

D. Challenge: What is Necessary for Success?

Environmental quality improvements have occurred nationally throughout the latter half of the twentieth century. These improvements are linked directly to local, county, state, interstate, and federal efforts to design and implement environmental



protection measures. The results of those measures, in terms of natural resource protection, benefits to human health, and improvement and protection of quality of life, have been dramatic.

This Plan represents an opportunity to build on the success of the past by adopting a new approach to environmental protection — based on a global environmental perspective, watershed management, and sustainable development. Conference participants acknowledge the fine balance which must be struck between our use of the Estuary and our protection of its natural resources, which have supported us for hundreds of years. To achieve this balance will require regionally coordinated action, pollution prevention, and public/private partnerships.

Government agencies alone cannot achieve sustained environmental improvements. The cumulative effects of the day-to-day decisions made by the millions of people who live, work, and play in the Delaware Estuary watershed can greatly outweigh the environmental benefits of a particular governmental program. We must change the way we think and operate, individually and collectively. In addition, instead of simply controlling problems or mitigating the impacts of our actions on the environment, we must work to avoid the problems from the start. Actions included in this Plan recognize that each stakeholder and interest group in the watershed, as well as all levels of government, have an opportunity and an obligation to contribute to identified solutions.

**We must
change the
way we think
and operate,
individually
and
collectively,
and work to
avoid
problems
from the
start.**

This is the challenge of the Delaware Estuary Program and the proof of a successful Plan.

E. CCMP Organization

This draft CCMP is organized as follows:

Chapter II presents the State of the Estuary — an overview of the status and trends of Delaware Estuary resources, based on numerous studies conducted by the Program over the last five years.

The next five chapters, Chapter III through Chapter VII, present actions for each of the priority areas of focus of the Program: Land Management, Water Use Management, Habitat and Living Resources, Toxics, and Education and Involvement. Chapters VIII and IX present an overview of the Monitoring strategy and

Regional Information Management Service. A total of 77 recommended actions are described in these seven chapters.

Chapter X presents the Unfinished Agenda, an overview of longer term program needs for study and potential action.

The final Chapter, Chapter XI, provides information on how the plan will be implemented, including a proposed post-CCMP structure for implementation and how the plan will be financed.

In addition to this draft CCMP, several companion documents are available through the U.S. Environmental Protection Agency (USEPA). A listing of these documents is provided in Appendix D.



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CHAPTER II: State of the Estuary

The Delaware Estuary is one of the most heavily used estuary systems in the Nation. The Estuary supports one of the world's greatest concentrations of heavy industry, the world's largest freshwater port, and the second largest refining-petrochemical center in the U.S.; about 70 percent of the oil, over one billion barrels, reaching the east coast of the U.S. is transported through the combined Ports of Philadelphia, Camden, Gloucester City, Salem, and Wilmington. The Estuary also receives wastewater discharges from 162 industries and municipalities and approximately 300 combined sewer overflows. The Delaware River Basin provides about 10 percent of the U.S. population (20 million people) with water for drinking and industrial uses. Much of this water is transferred out of the Basin.

The Delaware Estuary is one of the most heavily used estuary systems in the Nation.

The Estuary is also an important ecosystem. It is internationally important as a resting and feeding area for millions of migrating birds each spring and fall. Rare and endangered species also rely on the Estuary. It is known for its wetlands, commercial fisheries, and horseshoe crab spawning. It is a region where many biogeographic provinces come together, resulting in overlapping habitat types and high biodiversity.

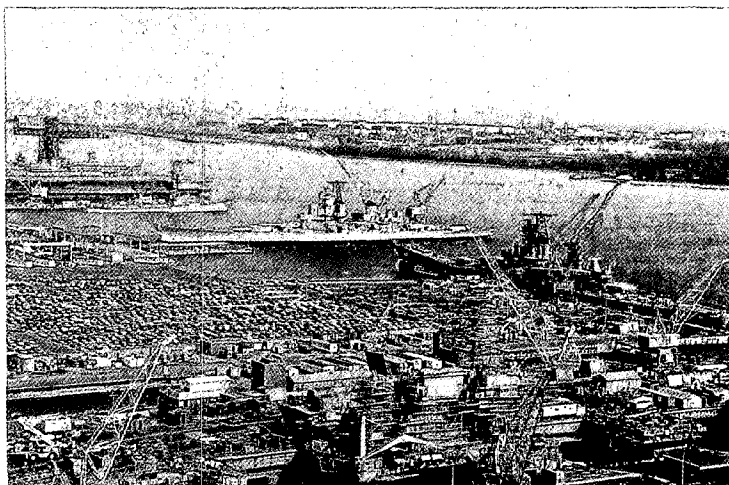


Figure 8. Philadelphia shipyards.

As a recreational resource, the Estuary is important to thousands of people who enjoy a variety of water-related activities, including boating, fishing, rowing, birding, and hunting. These activities depend upon clean water, protected habitat, and public access — which are key objectives of the Delaware Estuary Program. In many communities throughout the Estuary, recreation and related activities are important components of the local economy. These uses of the Estuary support thousands of jobs and demonstrate



the need to strike a balance between economic development and environmental protection.

This chapter, the State of the Estuary, provides the best available scientific and technical information to support the proposed actions in this CCMP. Current knowledge about the Delaware Estuary is summarized in the following areas: Physical Characteristics, Land Use, Water Use, Water Quality, Toxic Substances, Habitat, and Living Resources. These topics interact at many temporal and spatial scales, and effective Estuary management and conservation efforts recognize this interaction.



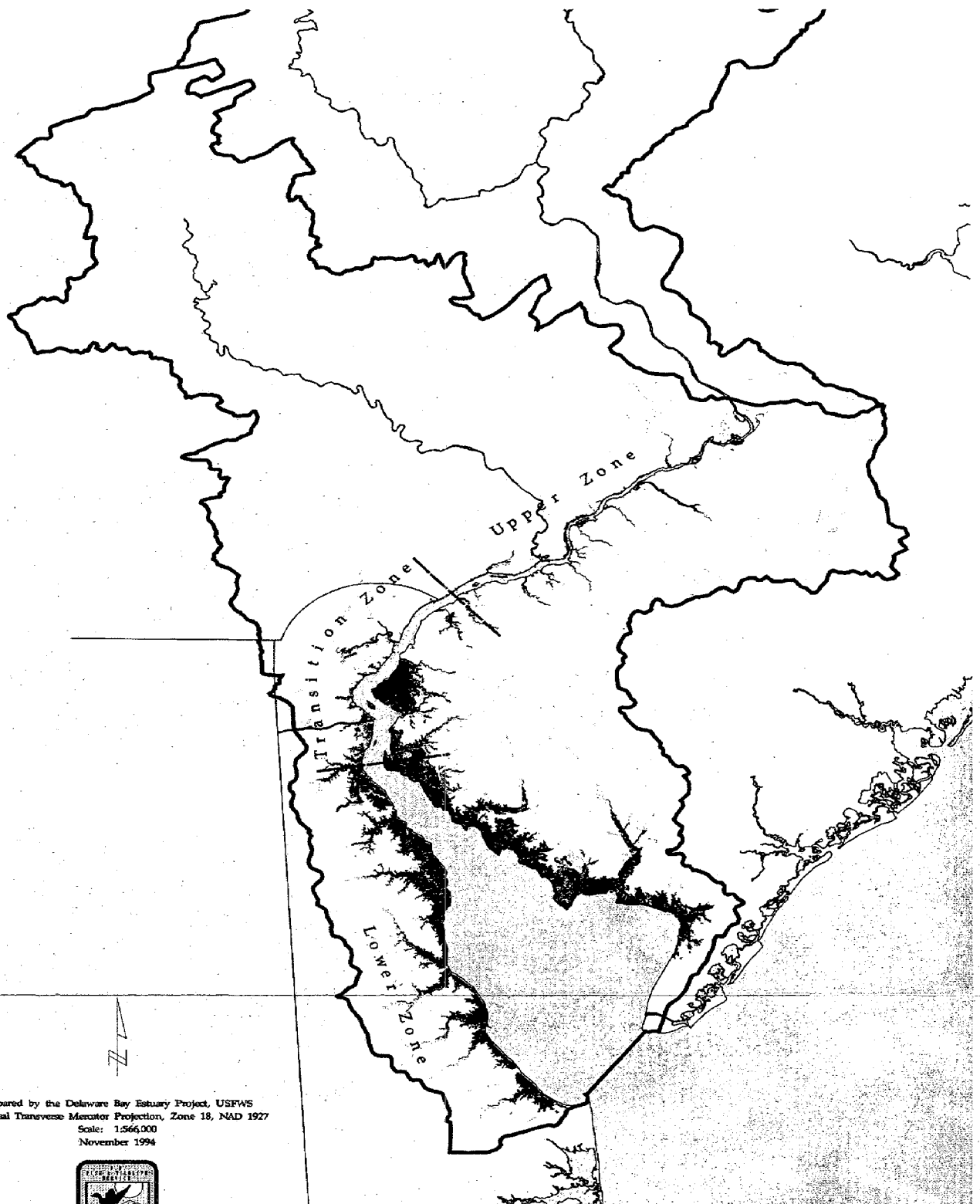
Figure 9. Redknots, ruddy turnstones, sanderling and laughing gulls (background) feast on horseshoe crab eggs. (Photo: Bill Buchanan).

A. Physical Characteristics

The entire Delaware River drainage basin includes parts of four states (Pennsylvania, New Jersey, Delaware and New York), encompasses about 35,000 km² (13,500 square miles), and is home to almost 8 million people. The Delaware Estuary is 215 km (134 miles) long, stretching from the fall line at Trenton in the north to the point where the Estuary enters the Atlantic Ocean between Cape May Point, New Jersey and Cape Henlopen, Delaware. The estuarine region, from Trenton, New Jersey to the sea, has about 6 million residents and the fifth largest population density of any northeast estuary.

There are three major ecological zones of the Estuary, distinguished by differences in salinity, turbidity, and biological productivity. The Upper Zone is tidal freshwater and extends from Trenton to Marcus Hook. Since colonial times, this area has experienced the most severe impacts from development and industrialization. The Transition Zone, from Marcus Hook to Artificial Island, has a wide salinity range (0-15 parts per thousand (ppt)) and is characterized by high turbidity and low biological

Ecological Zones and Tidal Wetlands



Prepared by the Delaware Bay Estuary Project, USFWS
Universal Transverse Mercator Projection, Zone 18, NAD 1927
Scale: 1:566,000
November 1994

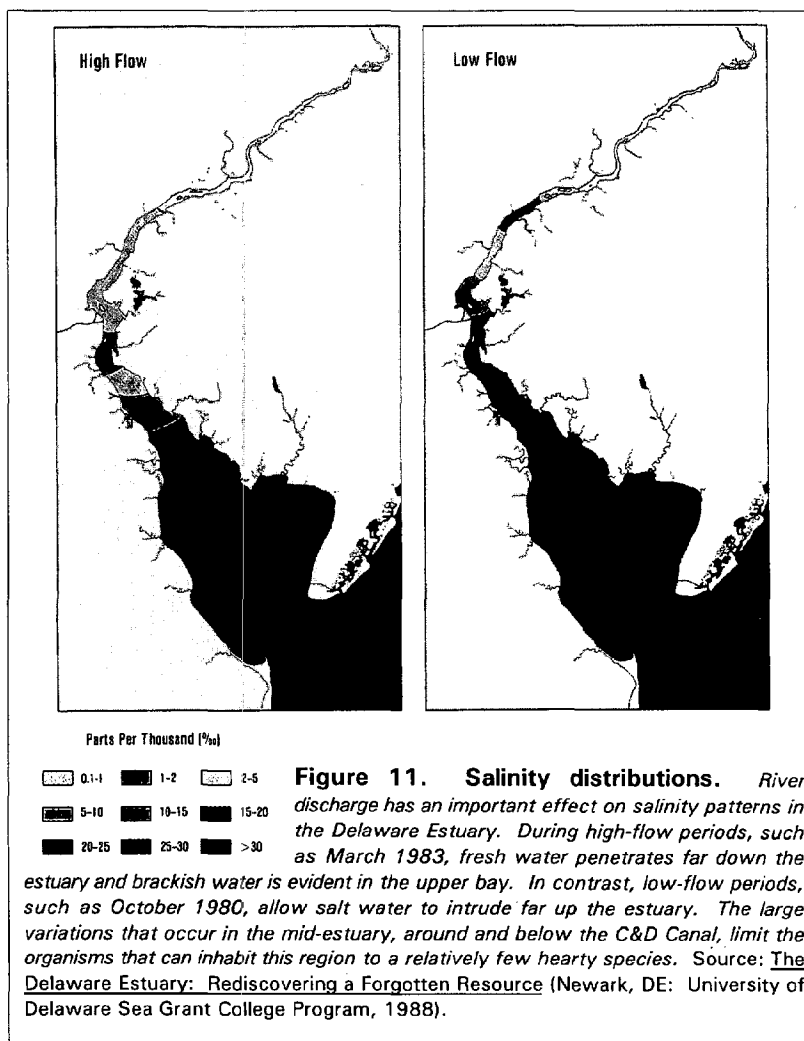


Figure 10. The Delaware Estuary Ecological Zones and Tidal Wetlands.

productivity. The Lower Zone is open bay and extends to the ocean. It has higher salinity and broad areas of fairly shallow water (<9 meters). This Lower Zone has the highest (over 90%) primary biological production (Pennock and Sharp, 1986) of the three zones.

The hydrodynamics of the Estuary are influenced by freshwater flow, tidal circulation, and wind. About 60 percent of the freshwater flow into the Estuary is from the non-tidal Delaware River, with about 10 percent from the Schuylkill River, and the remainder from the Chesapeake and Delaware Canal, small rivers, and nonpoint source runoff (Sharp *et al.*, 1986; Marino *et al.*, 1991). This fresh water mixes with saline water from the ocean, creating the variable salinity distribution found in the Lower Zone. The tidal range at the mouth of Delaware Bay is about

1.3 meters (4.25 feet); at the head of tide at Trenton, the tidal range is about 2.5 meters (8.25 feet). Because of channel deepening and other changes, including decreased freshwater flow, the tidal height at Trenton has increased, nearly doubling since 1890 (Hires *et al.*, 1986; DiLorenzo *et al.*, 1992). The upstream intrusion of saline waters to the Estuary has also increased during the last 50 years (Smullen *et al.*, 1984), probably the result of a combination of sea level rise, channel deepening, and upstream removal of freshwater. Drought conditions also affect the upstream range of salty water.





The Delaware Estuary is a tidally dominated estuary. The ratio of measured flow, tidal to freshwater, is 300:1 at the mouth of the Bay. Because of this strong tidal flow, the Delaware is vertically well mixed and only partially stratified. This well mixed nature of the Delaware Estuary has major implications for water quality (DiLorenzo *et al.*, 1992). The unique shape of the Delaware Estuary and its strong tidal influence result in a well mixed Estuary from top to bottom in summer, fall, and winter. This is in sharp contrast to the Chesapeake Bay, where very strong stratification between the top and bottom occurs in the summer, creating stagnant, low oxygen bottom waters. In the Delaware Bay, some stratification can occur during high freshwater flow periods, such as during the spring runoff from March to early May, but this does not persist. Thus, the hydrological conditions that allow low oxygen levels to develop in other estuaries in the summer do not exist in Delaware Bay (Sharp *et al.*, 1982). The average flushing time for the Estuary is about 90 days (Sharp, 1984). At the present time, the persistently oxygenated conditions and rapid water exchange decrease the impact of substantial loadings of certain pollutants, compared to other estuaries. The relatively large tidal excursion, approximately 10 km (8 miles), means that plants and animals in the water travel a considerable distance each time the tide goes in and out. This large tidal displacement introduces large intratidal variability in the cycle and causes significant short-term variability in local estuarine water quality.

B. Land Use

"Land use" is a term that refers to the way land is developed or preserved: where we put houses, shopping centers, parking lots, highways, farms, and parks. It is of concern to the Delaware Estuary Program because development of a piece of land has many effects on its ecology and, consequently, on the quality and quantity of the water that flows over it (rainwater or melting snow), through it (streams and rivers) and under it (groundwater). Development also has effects on wildlife, by altering habitat for nesting and nursery grounds, food, and protection; and it has effects on public access to waterways.

Demographic predictions provide compelling evidence for planning for growth and protection of our natural resources now. Nine of the ten most densely populated U.S. counties are in the Northeast. By the year 2010, 56 coastal counties in the Northeast are projected to have a population density greater than 800 persons per square mile, or 10 times the projected national average

Demographic predictions provide compelling evidence for planning for growth and protection of our natural resources now.

(Culliton *et al.*, 1990). While not all of these counties are within the Delaware Estuary's watershed, many of the people living in them will be using Delaware Estuary resources, including water from the Delaware River.

Of the 22 counties in the Delaware River Basin region, 10 had more than a 20 percent increase in population growth between 1970 to 1990. This population growth has created an increased demand for land for housing, transportation, and commercial uses. Bucks and Montgomery Counties each added over 70,000 new housing units during this period, while Chester and Burlington Counties each added over 50,000 units. Berks, Delaware, Camden, Gloucester, and Mercer Counties each added over 20,000 housing units during this period.

Population growth, and the demand for new housing, shopping centers, and places of employment, is projected to continue throughout the region between now and the year 2020, with an overall increase of 14 percent. This increase is not projected for the more urban counties, such as Philadelphia and Delaware, which have level or declining populations. While Philadelphia is projected to lose 5 percent of its population (76,000 people) by 2020, the States of Delaware and New Jersey are expected to see a population increase of 24.3 percent and 21.5 percent, respectively, by that date (Seymour, 1994). The Delaware Valley Regional Planning Commission has analyzed land use in its nine county region as of March 1990, and used that data to project land

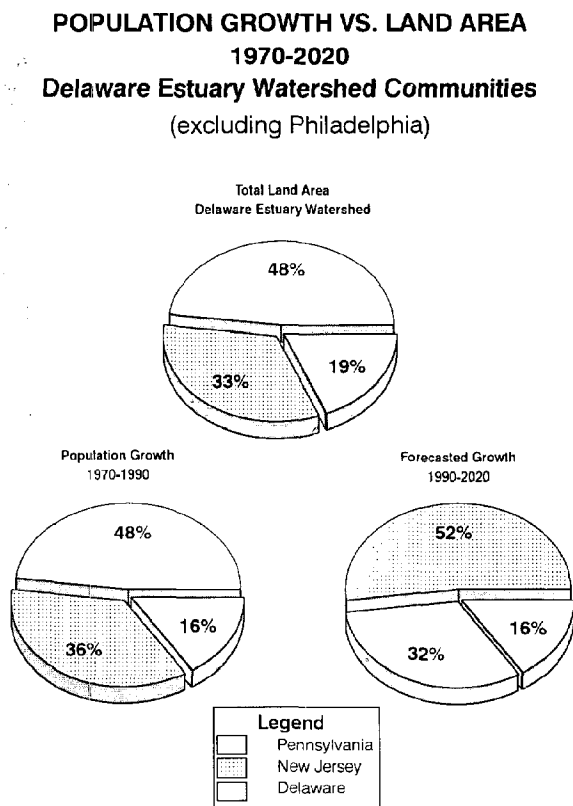


Figure 12. Population growth vs. land area. Adapted from Delaware Valley Regional Planning Commission, June 1994. Sources: US Census Bureau; NJ Dept of Transportation; PA Department of Environmental Resources; University of Delaware.



consumption to the year 2020. As of 1990, 37 percent of the area was developed and 63 percent undeveloped. By 2020, an additional 14 percent, or over 50 percent of the total land area, is projected to be developed. Less than 50 percent of the land will remain as agricultural, wooded, or vacant land or water (Seymour, 1994).

Coastal species, habitats, and ecosystems are under considerable additional stress from development pressures and are becoming less resilient as human population densities increase. Any trend that moves people away from cities and into more rural areas puts pressure on the remaining habitats; the loss of uplands, including forests and farms, is a particular threat. In fact, a significant trend in the region is the replacement of agricultural land with urban or suburban areas, particularly in the upper watershed, coupled with losses or alteration of forested tracts due to development in Delaware and southern New Jersey.

Changes in the nature of economic activity also have a big impact on land use and landscape. A shift from manufacturing to service jobs means that employment centers can be more dispersed. From 1970 to 1990, manufacturing employment in the region decreased by 13 percent, as other sectors increased. Agricultural employment is projected to remain stable through 2020; however, low density residential development may make farming more difficult.

Shoreline development is another land use trend. Although shoreline creation and filling are now limited by law, reconstruction and more dense housing are increasing the population along the Delaware Estuary's shores. This increased population brings with it the potential for increased pollution from point and nonpoint sources and increased water supply demands. In

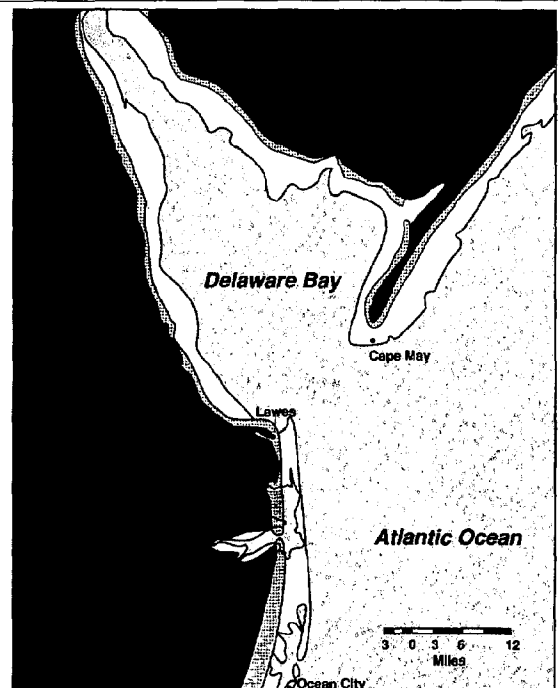


Figure 13. A projection of Delaware's Coastal Zone geography accompanying a rise of sea level to approximately 20 feet. The projected coast (gray shaded areas) is based on sea levels equivalent to those in several interglacial periods over the past 2 million years. This projection could occur again under four different scenarios: in 100-200 years with extreme predictions of climate warming; in 1,500 years should sea level continue to rise at rates we have had over the past 50 years; in 2,900 years at rates similar to the past 900 years; and 4,800 years at the average rate of the past 2,000 years. From "Sea Level Rise," *Delaware Estuary Situation Report Series* (Newark, DE: University of Delaware Sea Grant College Program, 1991).

addition, shoreline development is impacted by another well-documented trend, that of shoreline erosion. Many structures in the lower Estuary, which were once located on the shore, or even well inland, are now located at the water's edge or have disappeared. Another related concern of shoreline development is the historic rise in sea level. Some scientists believe the rate of rise is going to increase significantly due to global warming. Although there are disagreements about the rate of such a rise, increases have the potential to flood shorelines; this threat is exacerbated by the violent storms (both hurricanes and winter storms) which have battered the Atlantic coast and lower Estuary in recent years.

C. Water Use

Increased population and development directly impact water supply and the use of the Estuary for economic and recreational purposes. Increasing water demands have resulted in periodic water supply shortages and regional groundwater overdrafts, especially from aquifers in the coastal plain of New Jersey and in southeastern Pennsylvania. In addition to drawdown, water supplies are also threatened by salt water intrusion to deeper aquifers and the inland movement of the salt/fresh transition zone. Although not as well studied, other water supply concerns include the increasing depletion of tributary streamflows and transfer of wastewater out of the Delaware River Basin.

Twenty million people currently rely on the Delaware River Basin for drinking water. The largest user is New York City which diverts water from the headwaters of the river system. None of this water is returned to the Basin or Estuary. Based on a 1954 U.S. Supreme Court decree, New York City has the right to divert an average of 800 million gallons a day (mgd) of water from the Basin, provided that the City sustains a flow in the Delaware River of 1,750 cubic feet per second (cfs) at Montague, New Jersey. The City owns three large reservoirs in the upper parts of the Basin. However, under a recurrence of the 1960s drought conditions, the terms of the 1954 Decree, with respect to both exportations to New York City and the Montague flow objective, cannot be met with the reservoir storage capacity available. A program to reduce exportations and maintain flow objectives at Montague during drought periods was included in the 1982 "Good Faith Agreement" signed by the Governors of the four Basin states and the Mayor of New York City. The "Good Faith Agreement"

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is a compilation of 14 recommendations that constitute a series of interrelated management steps designed to respond to changed conditions in the Basin. They are organized around a long-term salinity standard to be achieved through the development of a new reservoir storage and flow augmentation capacity, water conservation, drought management, and the regulation of new or expanded depletive uses. A Delaware River Basin Commission (DRBC) Resolution (No. 83-13) provides for equitable sharing between downstream users and upstream exportation interests under future water shortage conditions. The Basin experiences three droughts every ten years (Goodell, 1988).

Figure 14 depicts 1991 average annual water withdrawals in the Delaware River Basin. These data were obtained in response to a recent DRBC regulation (Resolution No. 86-12) which requires water users to meter, record, and report their water withdrawals. Total in-Basin water withdrawals average more than 7.3 billion gallons a day. Water withdrawals decreased six percent between 1987 and 1991. This is due primarily to a reduction in power generation withdrawals stemming from a greater reliance on closed-cycle cooling systems and the use of cooling towers as opposed to once-through cooling systems which require more water to operate. Power generation water withdrawals constitute 68 percent of total withdrawals. Industry and the public water supply sectors comprise most of the remaining withdrawal, each at 15 percent of total withdrawals. Commission staff anticipate that, despite increasing population growth, water withdrawals should continue to decline as a result of the Commission's water conservation efforts, particularly its regulations requiring low flow plumbing fixtures and fittings and leak detection and repair. Also, it is likely that industries and power plants will continue to rely on and convert to closed-cycle cooling systems in lieu of once-through systems.

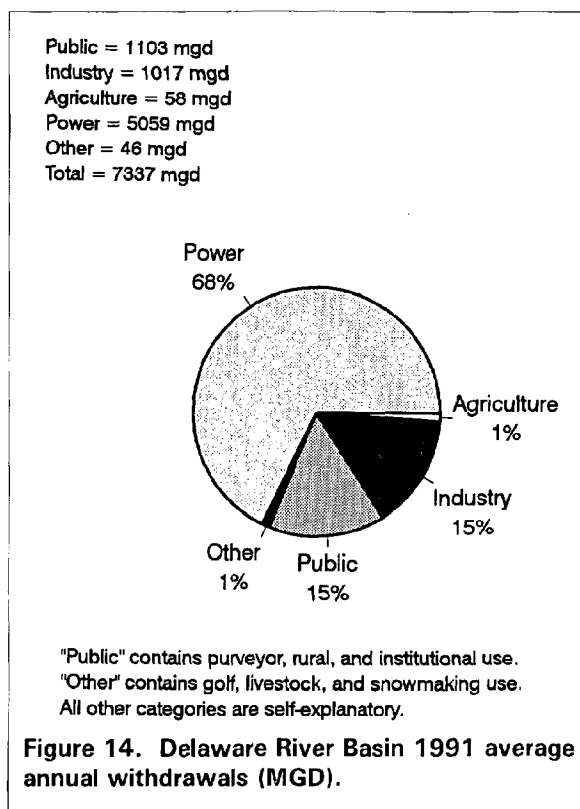
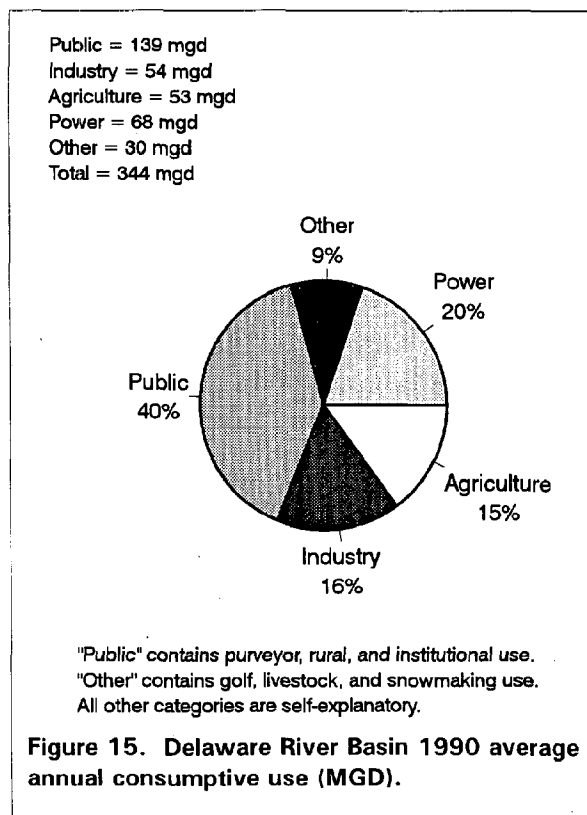


Figure 15 shows 1990 in-Basin average annual consumptive water use as estimated by DRBC in its most recent Water Resources Program (1990-1991). Consumptive water use is the loss of water from the Basin either through evaporation, evapotranspiration, or through incorporation into products via a manufacturing process. Consumptive water use is of particular concern to water managers because this water is not available for re-use or instream flow protection. These estimates were either reported by individual water users or derived by Commission staff based on available information. As noted in Figure 15, consumptive use is greatest in the public water supply sector. During the spring and summer months, there is extensive consumptive use in this sector stemming from lawn and garden watering and air conditioning. This component is measured by comparing peak seasonal versus winter average water use. Other large consumptive uses include agriculture, industry, and power generation.

The water that is evaporated through power generation can now be made up during dry periods by releasing water from Merrill Creek Reservoir, the Basin's newest impoundment located just off the Delaware River near Phillipsburg, New Jersey. The 16 billion gallon storage facility, completed in 1988, was built by a consortium of electric utilities at the direction of the Commission. When the Basin is under a drought warning and flows fall below the normal Trenton objective of 3,000 cfs, the utilities must release water from the impoundment to make up for evaporative losses at their riverbank generating stations.

Figure 16 depicts projected consumptive water use in the Basin for the year 2020 as identified by DRBC's Water Resources Program. Average annual consumptive use is projected to increase from 344 mgd in 1990 to 440 mgd by the year 2020. Estimated peak seasonal consumptive use is projected to increase from about 555 mgd to about 736 mgd in 2020 (Interstate Water





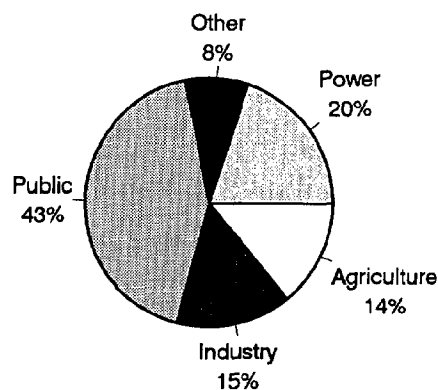
Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 to the Delaware River Basin Commission, pursuant to Commission Resolution 78-20). The largest increases are projected for the public water supply and power generation sectors. These projected increases reflect continuing needs for water for domestic purposes and air conditioning to support an expanding population base. The Basin's population is expected to increase from 7.3 million to 8.4 million by the year 2020.

Increasing water withdrawals also increase salt water intrusion into aquifers which supply drinking water. An excessive level of salt in drinking water is a well known risk to public health. The interim salinity standard adopted by DRBC for protecting the drinking water of the Delaware Estuary is a maximum 30-day average of 180 mg/l of chlorides and 100 mg/l of sodium at river kilometer 158 (river mile 98), one mile upstream of the Walt Whitman Bridge. An agreement signed by the four Basin states and New York City recommends that a more protective standard (150 mg/l of chlorides and 83 mg/l of sodium) be established by the year 2000. This more protective standard cannot be met with current reservoir storage capacity (approximately 413 billion gallons), projected sea level rise, and increasing consumptive uses (DRBC, Water Resources Program, 1990-1991).

Industries use the Delaware Estuary as a source of water for cooling and as a depository for waste discharge. Currently, these activities are concentrated in the upper Estuary while the shoreline of the lower Bay remains relatively free of large industrial activities.

Shipping is important to the economy of the Estuary region. To support Port operations and accommodate increasingly larger ships, government-authorized dredging has been conducted in the Delaware Estuary since the latter part of the 19th century. The

Public = 190 mgd
Industry = 68 mgd
Agriculture = 60 mgd
Power = 88 mgd
Other = 34 mgd
Total = 440 mgd



"Public" contains purveyor, rural, and institutional use.
"Other" contains golf, livestock, and snowmaking use.
All other categories are self-explanatory.

Figure 16. Delaware River Basin 2020 projected average annual consumptive use (MGD).

ship channel today is 13 meters (40 feet) deep. To maintain this depth, about 5.5 million cubic yards of sediment are dredged on an annual basis (See Table 1 and Figure 18). The dredged sediment was historically deposited largely on Estuary shores and marshes, creating areas that were later developed for industry.

Dredging has resulted in increased tidal range (DiLorenzo *et al.*, 1993) and increased shoreline erosion caused by ship wakes. These factors have resulted in decreased intertidal vegetation in the Upper and Transition Zones of the Estuary (Ferren and Schuyler, 1980).

Another major aspect of water use of the Delaware Estuary is the use of the River and Bay for recreation. Dramatic improvements in water quality over the last 20 years have increased the value of the Estuary as a recreational resource. The River and Bay are used for fishing, crabbing, boating, and sailing. Over 2.4 million people visited the upper Basin (Delaware Water Gap National Recreation Area) in 1986 (Karrish, 1988); comparable data are not available for the Estuary.

The economic value of sport fishing in Delaware Bay alone (both New Jersey and Delaware) is estimated to be about \$25 million per year (Kerlinger, 1991). Hunting, particularly waterfowl hunting, is important to the economy in rural sections of the Estuary.

In recent years, the economic value of the fishing and boating industry has been augmented by Estuary-dependent ecotourism. At Cape May, New Jersey, alone, over 90,000 birders spent \$5.5 million in 1988 (Kerlinger, 1991). Much of this economic boost was in the "off-season".

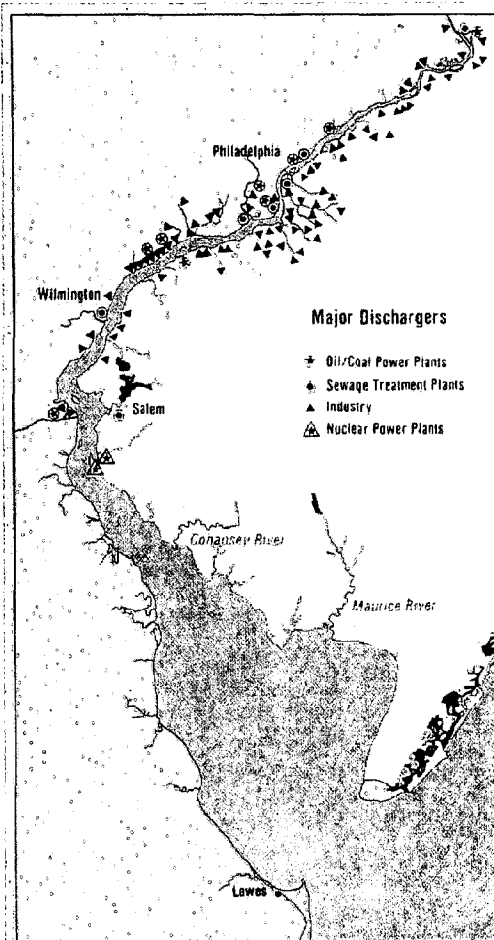
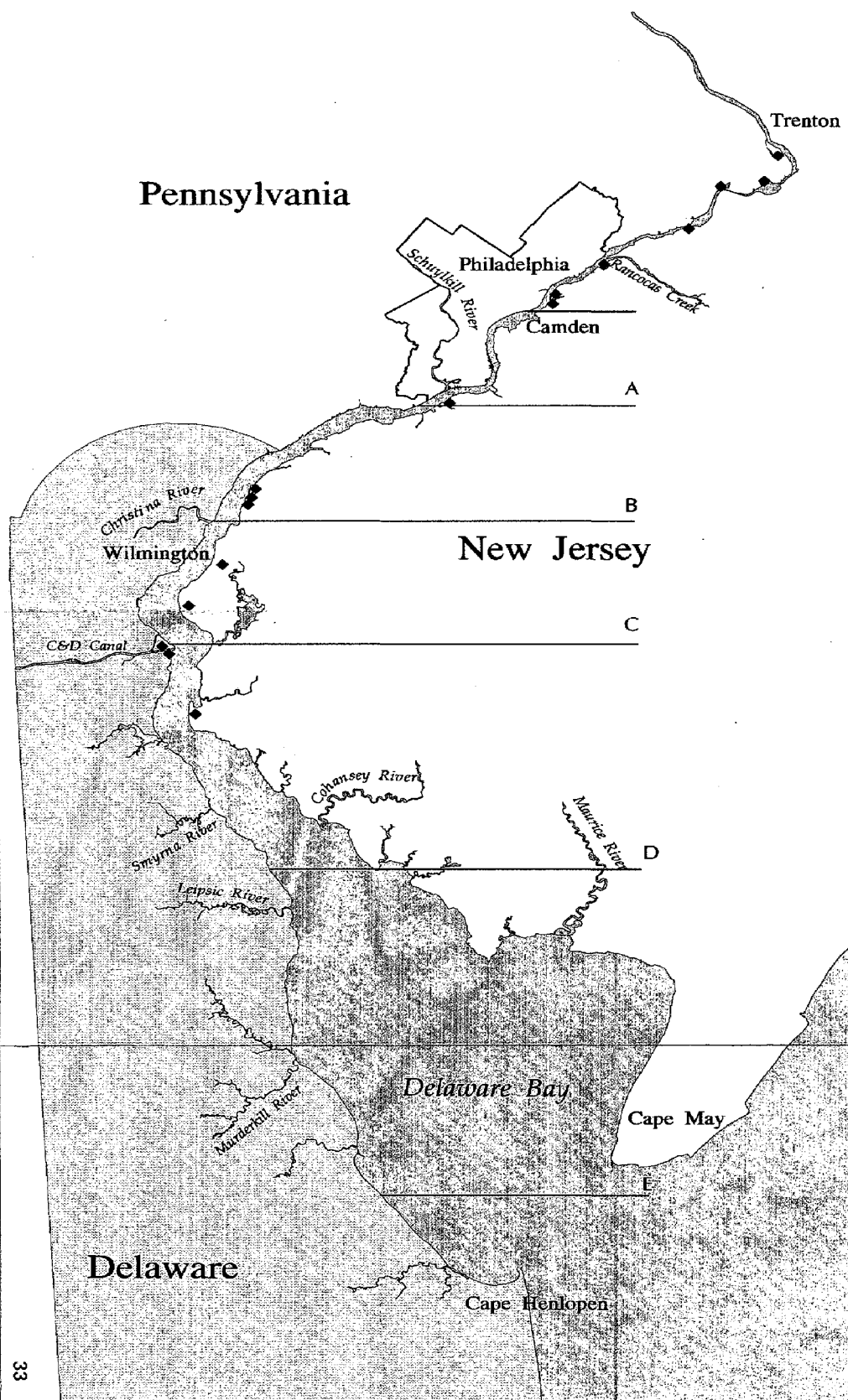


Figure 17. Major dischargers. Reproduced from *The Delaware Estuary: Rediscovering a Forgotten Resource* (Newark, DE: University of Delaware Sea Grant College Program, 1988).

Table 1. Delaware Estuary Existing Project Quantities and Disposal Areas

Project	Reach	Disposal Area	Maintenance: Cubic Yards/Year	Disposal Capacity
Delaware River, Philadelphia to Sea	A	National Park	260,000	Site can be used until 2007 at existing dike heights and could be extended to 2027. New site then required to replace National Park.
	B	Pedricktown North and South Oldmans	2,647,000	With further dike raising and extended use of Oldmans Creek Disposal Area, can defer new sites acquisition until year 2030.
	C	Penns Neck & Killcohook	2,257,000	Sufficient capacity until 2014 at existing dike heights and could be extended with dike raising throughout 50 year planning period.
	D	Artificial Island	340,000	Sufficient capacity exists for over 50 years.
	E	Buoy 10	48,000	Sufficient capacity exists for over 50 years.
	Total		5,552,000	
Christina River, Wilmington Harbor		Wilmington Harbor and Wilmington Harbor South	680,000	A disposal area evaluation is being initiated. With transfer of the Cherry Island Disposal Area to Delaware Solid Waste Authority, a new disposal site may be required in less than 10 years.
Schuylkill River		Ft. Mifflin	160,000	Sufficient capacity exists for over 50 years.
Delaware River, Philadelphia to Trenton		Multiple Sites	50,000	Sufficient capacity exists for over 20 years. Two new disposal sites will then need to be acquired.
Delaware River to Chesapeake Bay, C&D Canal		Multiple Sites	less than 200,000	Sufficient capacity exists in the portions within Delaware for over 50 years.

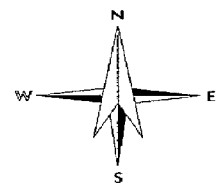
Delaware River Disposal Areas



Legend

◆ Existing Disposal Sites

— Reach Delineations



Scale: 1" = 9 Miles



**US Army Corps
of Engineers**
Philadelphia District

This map was produced by the U.S. Army Corps of Engineers, Philadelphia District, Planning Division Geographic Information System (GIS). Portions of digital data were provided by: NJDEP, PENNDOT and DELDOT.

October 1994

Figure 18. Delaware Estuary disposal areas for federal projects.

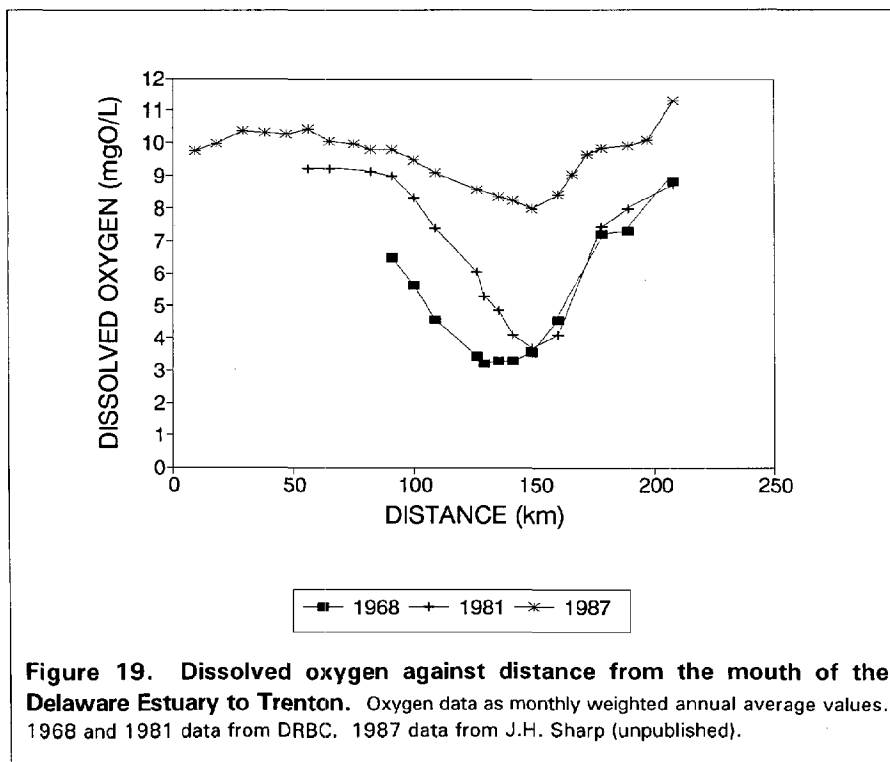
D. Water Quality

Water quality is an important issue in the Delaware Estuary because of the heavy demands for drinking water, industrial water use, and recreational and commercial fisheries.

There have been dramatic improvements in water quality, since the 1960s, including the return of oxygenated conditions during the entire year. A major emphasis on sewage treatment has resulted in a decrease in the biochemical oxygen demand (from bacterial respiration) and some decreases in the major nutrient inputs of nitrogen and, especially, phosphorus. Fecal

coliform levels also have dropped significantly, even in smaller tributaries. Fecal coliform is a bacteria used as an indicator of health risks associated with using water for drinking, swimming, or shellfish harvesting. The River is now more alkaline because of reduced acid waste.

In spite of the many improvements, however, water quality is still not adequate to support fishable/swimmable classifications in the Camden/Philadelphia metropolitan area (DRBC, 1990; Frithsen *et al.*, 1991; Marino *et al.*, 1991). The Estuary, from River Mile 108.4, below the mouth of Pennypack Creek, to River Mile 78.8, the Pennsylvania and Delaware state line, does not meet federal criteria for fishable water; the Estuary, from River Mile 108.4, below the mouth of Pennypack Creek, to River Mile 81.8, the Commodore Barry Bridge, does not meet federal criteria for swimmable water.





The Delaware River Use Attainability Project (1989) found that wastewater treatment plants in this area would need to be upgraded to meet the fishable criteria. The Project also found that, until additional studies concerning the impact and correction of combined sewer overflows (CSOs) in the Philadelphia area can be conducted, uncertainties exist concerning the attainment of swimmable waters. CSOs, both illegal dry weather bypass and wet weather over-flows, degrade water quality.

The states have developed CSO

Control Strategies to comply with the 1989 USEPA National CSO Control Strategy. In 1994, USEPA issued its CSO Control Policy that elaborates on the National CSO Strategy and expedites compliance with the Clean Water Act. This Policy provides for a comprehensive approach to ensure that municipalities, permitting authorities, water quality standards authorities, and the public engage in a thorough and coordinated planning effort to achieve cost effective CSO controls that ultimately meet appropriate health and environmental objectives. In order to comply with the CSO Control Policy guidance and the requirements of the Clean Water Act, the three states and several urban areas, in coordination with DRBC, are developing site specific CSO strategies that are in compliance with state CSO strategies (See Action W13).

The Delaware Estuary still has one of the highest nutrient inputs of any major estuary in North America; urban wastewater is the major source of both nitrogen and phosphorus in the estuarine system. Sharp (1993) has shown that, on average, total phosphorus dropped dramatically in the early 1970s, but has

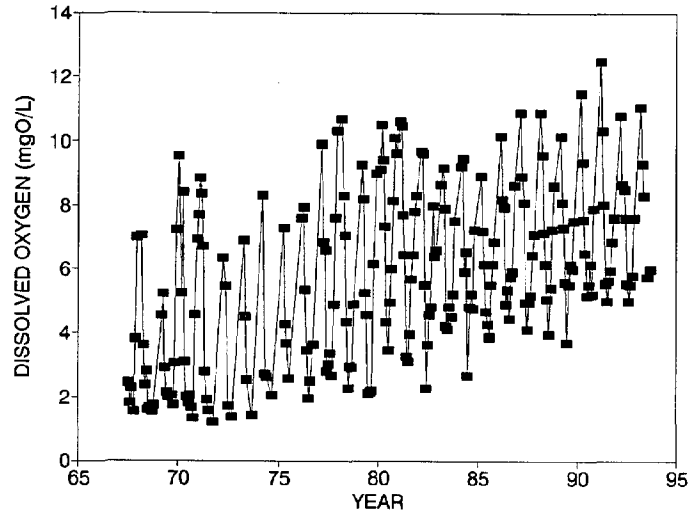
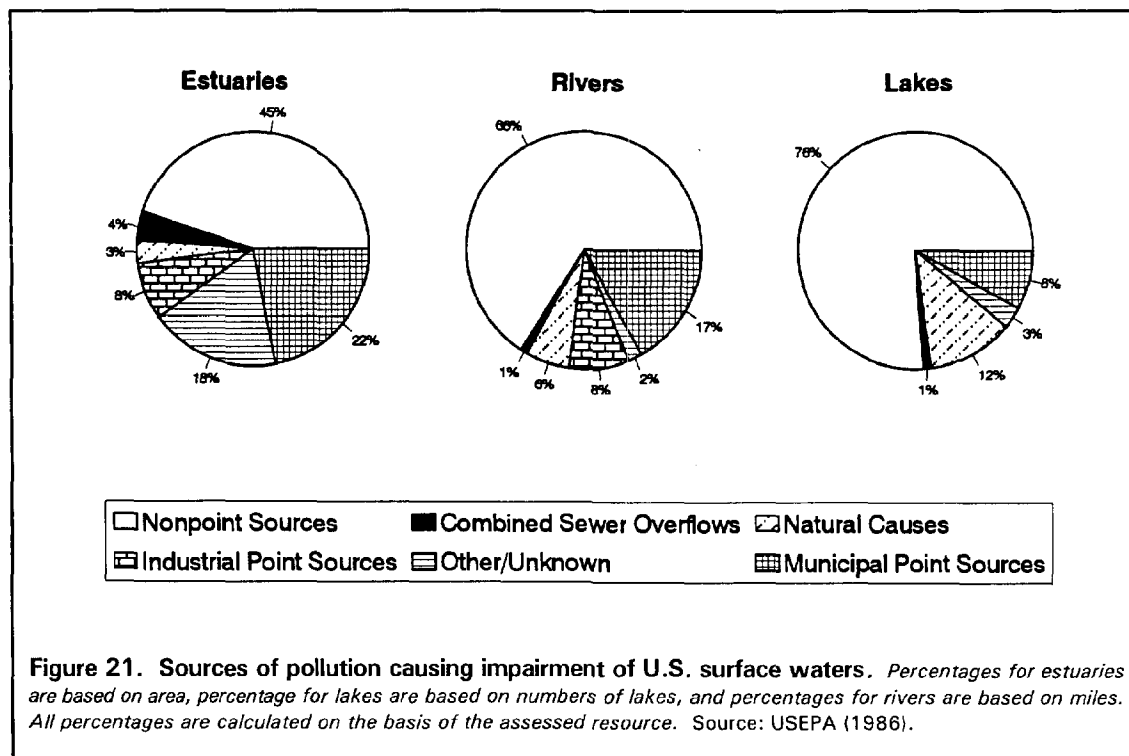


Figure 20. Dissolved oxygen concentration at Marcus Hook, 1967 through 1993. Data from DRBC.

stayed relatively constant since that time. Much of the phosphorus is lost by geochemical reactions (Lebo and Sharp, 1993). Ammonium concentrations have been steadily declining, with commensurate increases in nitrate concentrations. It appears that much of the ammonium has been oxidized to nitrate rather than removed from the system, although there has been some decrease in total nitrogen (Sharp, 1993). High nutrient levels usually provide ideal conditions for eutrophication, causing massive blooms dominated by cyanobacteria and diatoms (planktonic algae), but these do not usually occur in the Delaware Estuary. Rather, there are usually healthy populations of diatoms in both the tidal river and in the lower Estuary; the Transition Zone has low productivity because of high turbidity and less light penetration.

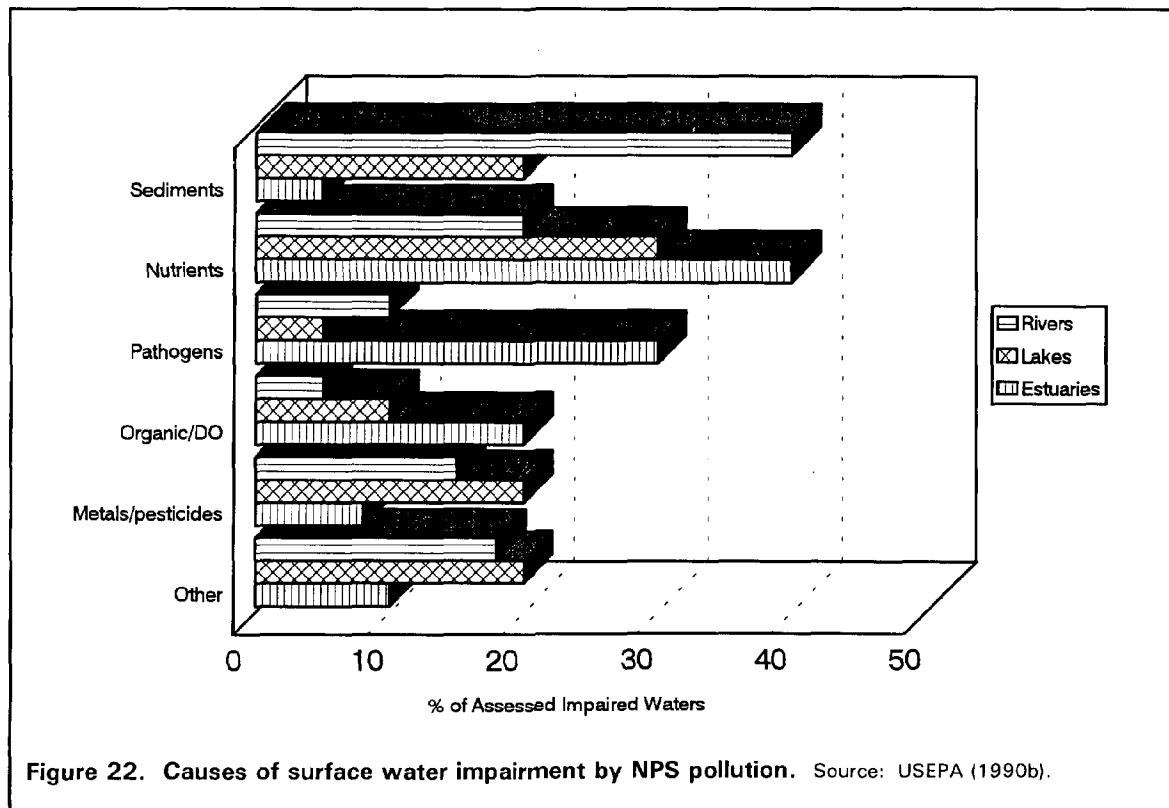


Roughly 65 percent of all river miles in watersheds draining to estuaries are impaired by nonpoint pollutants (USEPA, 1986) and 45 percent of all pollution impacts to estuarine ecosystems nationwide are attributable to nonpoint sources.

USEPA water quality impairment studies show that, of total nonpoint source pollutants in estuaries, 35 percent are nutrients,



28 percent are pathogens, 17 percent are organic dissolved oxygen, 7 percent are heavy metals and pesticides, and 5 percent are sediments (USEPA 305b Water Quality Reports, 1990).



Comprehensive data on nonpoint pollution impacts to surface and groundwater bodies throughout the Delaware Estuary region are still largely unavailable. Local watershed studies show that, since point sources are already subject to stringent regulation, nonpoint sources have become more significant water quality concerns.

In a study of the Upper Perkiomen watershed, Cahill Associates (1993) found that water quality in three reservoirs had been impaired to hyper-eutrophic conditions by phosphorous and suspended sediments in stormwater from agricultural and suburban uses. They determined that, although agricultural uses currently produce 80 percent of the nonpoint source pollution in the watershed, the conversion of farmland to suburban subdivisions would be the most likely cause of future nonpoint-related water quality impairments.

Like the reservoirs in the Upper Perkiomen watershed, Alcyon Lake in Gloucester County, New Jersey, is currently polluted to a eutrophic state. It remains threatened primarily by projected suburban development (with projected increases in nonpoint pollutant loadings of 22 to 52% of total loading). A watershed-based stormwater management plan calls for open space areas, runoff controls for new development, and forested buffers (Gloucester County Planning Department, October 1992).

Another study, focusing on nonpoint source pollution in the Delaware Estuary region, stated that "...decennial gains of up to 16% in suburban sprawl may represent a 45% increase in nonpoint source pollution by the year 2020" (Greeley-Polhemus Group, 1994).

To address water quality degradation problems in the Estuary region, the CCMP nonpoint source action plan (see Chapter III) calls for watershed-based land planning, the implementation of Coastal Zone Act Management Measures, riparian corridors, and the restoration of urban stream corridors.

E. Toxic Substances

The Delaware Estuary is impacted by toxic substances, mainly human-created chemicals which have been introduced to the waters. Elevated levels of a few toxic substances have been detected in the sediments, the water column, and in the tissues of organisms dependent on the Estuary. Toxic substances include heavy metals and organic contaminants, such as pesticides and polychlorinated biphenyls (PCBs). (See Chapter VI for a listing of pollutants of concern.) While there are few exceedances of USEPA's water quality criteria for toxic substances in the Delaware Estuary (McNair, 1991), there are concerns about long-term, chronic impacts. The highest concentrations of toxic substances occur in the urban area (McNair, 1991; Costa and Sauer, 1994). There may be some important point sources for metals, but the organic contaminants appear to be primarily from nonpoint sources. The levels of toxic substances in Delaware (Jacobsen *et al.*, 1989).

Elevated levels of a few toxic substances have been detected in the sediments, the water column, and in the tissues of organisms dependent on the Estuary.

TRACE METALS

In the Transition Zone, many water column metals are converted to particulate form by the action of seawater flocculation (Church



et al., 1988). Metal concentrations tend to decline from this zone to the ocean, probably as a result of increasing dilution by seawater and fewer dischargers in the Lower Zone. Zinc and copper have decreased significantly since 1970. Nickel has increased in the Upper and Transition Zones, and decreased down-bay. Chromium still exceeded water quality criteria sometimes in the late 1980s (McNair, 1991). Elevated metals in bottom sediments are associated with fine, organic-rich particles, especially near municipalities and in the central area of the Estuary (Church *et al.*, 1988). Dredging activities, and to some degree shipping and boating activities, resuspend sediments and potentially remobilize these metals.

Total loadings of arsenic, chromium, copper, and lead to the Delaware Estuary are approximately 100,000 kg/year (110 tons). A significant portion of these loadings originate from point sources discharging directly into the Estuary; however, nonpoint sources also contribute to the loadings. Urban runoff contributes significant metals to the Estuary. Agricultural runoff is a significant source of arsenic to the Estuary because of long-term use of inorganic pesticides. Atmospheric deposition contributes a small proportion of the total loadings of the metals arsenic, chromium, and lead. Urban runoff, point sources, atmospheric deposition, and groundwater all contribute significant amounts of mercury to the Estuary. The total loading of mercury is approximately 10,000 kg/year (11 tons) (Versar, 1994).

ORGANIC CONTAMINANTS

There is a trend toward increasing phenols, in all three zones of the Delaware Estuary, and decreasing volatile organic compounds in the Upper Zone (McNair, 1991). The highest levels of organic toxic substances are associated with the urban areas (Costa and Sauer, 1994). Chlorinated hydrocarbons are of particular concern because they biomagnify in biota. Some of these compounds can be formed as a result of water treatment by chlorination. Historical analytical problems with measuring many toxic organic compounds have made determination of long-term trends difficult; however, recent improvements in analytical techniques should improve our ability to measure contaminants and establish trends.

Most contributions of chlorinated pesticides to the Estuary are from agricultural runoff, amounting to approximately 10,000 kg/year (11 tons). Although the use of many of these pesticides is now severely restricted, previous long-term use in agricultural

areas caused contaminants to accumulate in soils that continue to erode into the Estuary. Point sources also remain a significant source of chlorinated pesticides (Versar, 1994).

The direct effects of toxic substances on biota, as well as accumulation in organisms, are not very well documented, either in the Delaware Estuary or elsewhere; however, toxic substances have been detected in the tissues of fish and shellfish in the Delaware Estuary. Chlorinated organic compounds such as PCBs, chlordane, and DDT and its related compounds have been found in fish tissue (Belton, *et al.*, 1982; Gastrich, 1992; DRBC, 1988; USFWS, 1993), and have resulted in fish consumption advisories for the entire Delaware Estuary.

FISH ADVISORIES

Fish and shellfish contamination and associated health risks to the consuming public have been identified among the key management issues of the Delaware Estuary Program. Fish consumption advisories provide information to the public concerning the extent of contamination, the fish species affected, the maximum number of fish which should be consumed from the water body, and ways to reduce health risk through proper preparation and cooking techniques. There are several advisories in place for the Delaware Estuary (See Table 2). For example, Pennsylvania and New Jersey have a health advisory for channel catfish, taken from the urban Delaware River, due to PCB contamination, and Delaware issued an advisory for striped bass in June 1994. However, there are currently no uniform procedures among the states for the detection and evaluation of fish tissue contamination in the Estuary and no coordinated program for informing the public of health risks from consuming tainted fish. Consequently, duplication of sampling effort has occurred while critical information needs have not been met. The result is incomplete and inconsistent advice to the public.

ECOSYSTEM EFFECTS

Chlorinated pesticides appear to adversely affect populations of birds of prey (raptors) in the Delaware Estuary. Although more study is needed, there is evidence that eggshell thinning due to toxic substances is continuing to affect the stability of raptor populations. Elevated levels of PCBs, DDT and its metabolites, and chlordane have been detected in peregrine falcon eggs from the Delaware Estuary (Jarman *et al.*, 1993). Eggshell thinning and

Fish and shellfish contamination and associated health risks to the consuming public have been identified among the key management issues of the Delaware Estuary Program.



Table 2. Fish Consumption Advisories for Delaware River and Bay

Issuing Agency	Fish Species	Areal Extent	Pollutants of Concern	Advisory
PADER/PADH	White Perch, Channel Catfish, American Eel	Yardley to PA/DE Line	PCBs, Chlordane	Do not eat
NJDEP/NJDOH	Channel Catfish	I-276 Bridge to Birch Creek	PCBs, Chlordane	Do not eat
NJDEP/NJDOH	American Eel	Statewide	PCBs, DDT, Chlordane	No more than 1 meal/week and no consumption for high risk groups*
NJDEP/NJDOH	Bluefish > 24" or > 6 lbs	Statewide	PCBs, DDT, Chlordane	No more than 1 meal/week and no consumption for high risk groups*
DNREC/DE DHSS	Striped Bass, White Perch, Channel Catfish, White Catfish	DE State Line to the C&D Canal	PCBs	Do not eat
DNREC/DE DHSS	Striped Bass, Channel Catfish, White Catfish	C&D Canal to Cape Henlopen	PCBs	Adults: no more than five 8 oz. meals per year; Children: no more than three 4 oz. meals per year
*Pregnant women, nursing mothers, women of child-bearing age, young children				

lower reproductive success have been reported for peregrine falcons nesting in the Delaware Estuary compared to other areas in New Jersey (Steidl *et al.*, 1991 b). Osprey reproductive success is almost 30 percent lower in the Estuary than along the Atlantic coast of New Jersey (Clark, 1991; Steidl *et al.*, 1991 a,c). A possible cause for this poor production in the Estuary is low hatching rates due to effects of environmental contaminants, although losses of eggs and chicks to predators, and poor brooding due to food shortages or predator harassment, are also suspected (Clark, 1991). In 1992, there were nine bald eagle nests in the Delaware Estuary. Of the four nests in Delaware, only one produced young; one of New Jersey's five nests failed to produce young. This failure rate of 44 percent is one of the highest rates of nest failures in the country for bald eagles (Niles *et al.*, 1991).

DRBC monitoring has detected chloroform, 1,2-dichloroethane, and toxic metals in the water column in the urban areas of the Estuary. Water quality exceedances for lead, copper, mercury, arsenic, chromium, and silver are a concern in the urban section of the Estuary. DRBC's November 1990 study found ambient water samples, collected under average flow conditions at the Delaware Memorial Bridge and between the Walt Whitman and Tacony-Palmyra Bridges, to affect the growth of fathead minnows (DRBC, 1991).

Toxic substances are present in the sediments as a result of point and nonpoint discharges to the Estuary and atmospheric deposition. Contaminated sediments may act as a source of continued contamination of the water and biota. DDT and associated compounds, polycyclic aromatic hydrocarbons (PAHs), copper, lead, zinc, chromium, nickel, cadmium, and mercury were found in the sediments in the greater Philadelphia area from Burlington to the mouth of the Schuylkill River. Lead, zinc, cadmium, pesticides, and some of the PAHs exceeded the National Oceanic and Atmospheric Administration (NOAA) ER-M (effects level-median), which is the level at which adverse effects are frequently observed in benthic species (DRBC, 1993).

In a 1994 interpretation of historical data, spatial distributions of acute sediment toxicity throughout the Estuary were determined and causative associations between chemical contaminants and acute sediment toxicity were identified (Costa and Sauer, 1994). In this study, PCBs were found to be far more widespread in sediments than previously indicated, and PAHs indicated several



different oil-related sources in the urban portions of the Estuary. Acute sediment toxicity was more widespread than previously documented, but this problem was concentrated along industrialized portions of the Delaware River. Primary causative contaminants appear to be oil-related PAHs, copper, and mercury; however, zinc and DDT-related pesticides and PCBs also imparted toxicity and were bioavailable to benthic organisms (Costa and Sauer, 1994).

The impacts of toxic substances on the ecology and behavior of particular organisms in the Delaware Estuary have been studied to a limited extent. There are often synergistic effects among toxic compounds, which can be further indirectly affected by other stresses on the organisms. More evidence needs to be gathered to document amounts and impacts of toxic substances on estuarine biota, especially those that are harvested for human consumption. This is a difficult problem because many of these compounds are potentially contributed from nonpoint sources. Federal, interstate, and state efforts are underway to better understand toxic substances, but increased sampling and analysis are critical. Further characterization of toxic substances in the Estuary is needed, including studies of toxic substances at lower trophic levels and their transfer through the food web.

F. Habitat

Habitat is the arrangement of food, water, shelter or cover, and space suitable to an organism's needs. Habitats may be small well-defined areas, such as the nesting and feeding area for a pair of ospreys, or they may encompass large regions if a species is migratory. Habitat can also be defined by the species that inhabit them. For example, oysters create surfaces with their shells for other species to live on, and oyster reefs support a diverse fauna in the water column and on the bottom. Habitats vary in time, temperature, salinity, human impacts, and other defining factors.

Habitats provide breeding, nesting, staging, and feeding grounds for waterfowl, shorebirds, raptors, songbirds, mammals, fish, reptiles, and amphibians. Forested areas and successional meadows are crucial to millions of migrating songbirds and to a diversity of reptiles and amphibians. Marine and estuarine habitats support species from the lowest to the highest trophic levels. Nationally, almost 35 percent of all rare and endangered animal species are either located in or dependent on wetland habitats,

Further characterization of toxic substances in the Estuary is needed, including studies of toxic substances at lower trophic levels and their transfer through the food web.

and 90 percent of the species of commercially important fish and shellfish either pass their entire lives in estuarine habitats or require estuaries as nursery grounds.

While some species are fairly adaptable and can flourish in a variety of habitats, many species have very specific requirements. These specific requirements can only be met for all the species in the Estuary by maintaining a diverse mix of upland, wetland, and deepwater habitats.

Over the past several decades, the extent and quality of important habitats in the Delaware Estuary have, in some cases, improved and, in others, grown worse. Many improvements are related to the regulatory and management systems which have improved water quality, reduced the rate of tidal wetland changes, restored or enhanced wetlands values and functions, and encouraged more sensitive development in coastal areas. Upland habitats have not fared as well, primarily because of the loss and fragmentation of these habitats for development and the lack of federal, state, and regional programs to address this issue.

OPEN-WATER HABITATS

Away from shore, the Delaware Estuary is a patchwork of various assemblages of species living on/in the bottom, primarily mollusks, worms, crustaceans, bottom-dwelling fish, and microbial decomposers. In the overlying waters, phytoplankton, crustaceans, larval stages of bottom-dwellers, fish and additional microbial decomposers are found. Different bottom types and water masses in the Delaware Estuary present different habitats and therefore contain different assemblages of species.

From place to place within the Estuary, the bottom habitats differ with respect to such factors as depth, light penetration, and inorganic sediment particle size and composition. Sediments vary in proportions of gravel, sand and mud, amount of associated organic matter, stability of the sediment in the face of currents, as well as concentrations of toxic substances that have entered the Estuary.

Although muddy patches are found in quiescent regions of the Delaware Bay, the relative contribution of mud and organic matter to the bottom composition is generally lowest in the Lower Zone, where there is more sand and gravelly sand. Mud and organic

Over the past several decades, the extent and quality of important habitats in the Delaware Estuary have, in some cases, improved and, in others, grown worse.



matter increase as one goes upstream (Biggs and Church, 1984). Metals and organic toxic substances in these muddy, organic sediments are highest in the Transition Zone (Church *et al.*, 1988; Little, 1993; Riedel and Sanders, 1993). While more research is needed, it is clear that pollution of these benthic habitats has affected the overall health of the associated species and the food webs they create. Besides physical displacement, little is known regarding the effects of channel dredging on benthic habitats, and this remains a research need.

Although the overlying water is churned and mixed by the currents, water masses differ from place to place in the Delaware River. The Upper, Transition, and Lower Zones are defined in part by differences in water salinity and turbidity (Biggs *et al.*, 1984; DRBC, 1988). Dissolved nutrients are highest in the upper sections of the Delaware River and are generally much lower near the mouth of the Estuary (Frake *et al.*, 1984). In addition, the water chemistry in urban sections of the Delaware River differs from that in nonurban sections; the Upper Zone has more wastewater-generated nutrients, as well as pollution from dissolved metals and organic toxic substances. (Academy of Natural Sciences, 1991; McNair, 1991; Gastrich, 1992).

The bottom and the overlying water, in any region of the relatively shallow Delaware Estuary, are coupled in the sense that they time-share biological components. Behaviorally controlled nocturnal and tidal vertical migrations (Stearns and Dardeau, 1990) provide regularly timed vertical shuttling of species between the two environments on short time scales (hours). The two environments are also coupled through variable physical vectors that induce mixing or allow sinking (Palmer, 1984). Also, most of the adults living on the bottom have larvae that live in the overlying water column. These larvae develop and eventually select specific bottom habitats within the Estuary, where they complete their life cycles. With the coupling and overlapping food webs between these two regions, it is clear that the benthos cannot be altered without affecting life in the surrounding water and vice versa.

SHELLFISH BEDS

The extent of oyster seed beds in the Delaware Bay remains unchanged since the early 1900s, and there is little evidence that water quality changes have affected their productivity. Oyster seed beds are limited to specific areas because of salinity, currents, and bottom conditions. Declines in oyster landings in

the 1930s and 1950s were due to the oyster drill and overharvesting; extreme declines since the mid-1950s are due to the MSX parasite, the oyster drill, and, more recently, the dermo parasite. The MSX parasite and the oyster drill are partly controlled by salinity, with lower salinities decreasing their impact. Since salinity is a factor in controlling oyster production, depletive water use can affect oyster production.

The oyster seed beds and planting grounds have not experienced closures due to contamination, but many beds in tributary streams have been closed to direct harvesting. The production of seed oysters on beds in the Delaware Bay seems comparable to production in other systems (Hargreaves and Krauter, 1989; Haskin *et al.*, 1984). With management, a better understanding of oyster diseases, and an understanding of requirements for seed production, it is expected that oyster production could recover (Haskin *et al.*, 1984).

WETLANDS

The Delaware Estuary is probably best known for its wetlands, which provide more than 405,000 acres (164,000 hectares) of habitat. More than 126,000 acres (51,000 hectares) of these wetlands have been recognized as

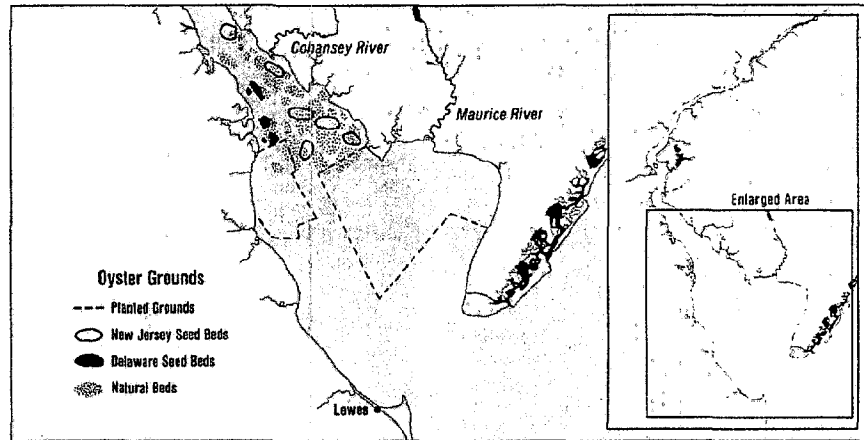


Figure 23. Oyster grounds. The oyster fishery ranges from the mouth of the Maurice River and shoals on the New Jersey side to the Smyrna and Cohansey rivers. The natural oyster beds are in the upper region, in lower salinity waters where predation and disease are at a minimum. Here, oystermen use seed beds to set young oysters, or spat, allowing them to grow through the first years of life. For the last year or two before harvesting, the oysters are transplanted to the planted grounds, where growing conditions are better. Unfortunately, predation by oyster drills and the MSX parasite is much greater in these lower beds, contributing to the fishery's decline. Reproduced from *The Delaware Estuary: Rediscovering a Forgotten Resource* (Newark, DE: University of Delaware Sea Grant College Program, 1988).

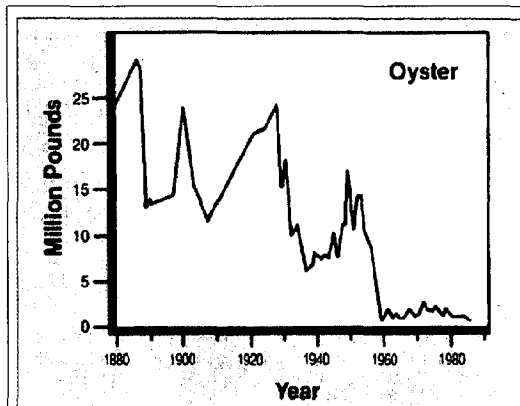


Figure 24. Oyster landings. The Delaware Estuary's oyster fishery landed more than 25 million pounds of oysters annually during the late 1800s. A major fishery continued into the mid-1900s until a combination of overfishing and the introduction of the MSX parasite decimated it. Between 1957 and 1960, 90-95% of the oysters on the planted grounds were killed by MSX. Reproduced from *The Delaware Estuary: Rediscovering a Forgotten Resource* (Newark, DE: University of Delaware Sea Grant College Program, 1988).



internationally important. The Delaware River Basin contains an estimated 762,000 acres of wetlands, about nine percent of the Basin's land surface area (Tiner and Wilen, 1988).

Wetland losses throughout the watershed have been significant, particularly between 1954 and 1974, and particularly associated with the Delaware Memorial Bridge. Possibly up to 21 to 24 percent of the originally existing wetlands of the Estuary region have been lost (Tiner, 1985, 1990; Frayer, 1991). Nontidal freshwater and forested wetlands have sustained the greatest losses, while tidal marshes have been less affected by development and other human activity. Much of the wetland areas remaining have been degraded by pollution, invasion of exotic species, and expansion of undesirable native species. Estuary residents are paying the price of these losses through water treatment costs, erosion, and the cost of flood protection and control. Losses have also resulted in reduced fish populations and reduced available water supplies through lack of groundwater retention and increased salinity.

Coastal wetlands, in some areas, can withstand modest rates of change in sea level, unless their landward movement is obstructed by development; but even the most conservative predictions for sea level rise will almost certainly outpace the ability of many coastal ecosystems to move inland or adapt (Reid and Trexler, 1991). Several important beach and marsh complexes are already experiencing erosion and excessive inundation and will be significantly reduced or lost unless management actions are taken (Meredith, 1994).

The region's tidal marshes below the Delaware Memorial Bridge have been legally protected from the intense development experienced in other coastal areas. However, the marshes have been extensively altered in past decades by parallel-grid ditching for mosquito control, construction of limited-purpose impoundments, modifications for waterfowl, salt hay farming, and agricultural use. There have been substantial losses of freshwater marshes and forested wetland habitat because of conversion to agricultural uses or modifications related to agriculture. Extensive management efforts are now underway to restore multiple values and functions in impounded wetlands, and more environmentally compatible mosquito control techniques are also being implemented.

Estuary residents are paying the price of wetland losses through water treatment costs, erosion, and the cost of flood protection and control.

Tidal and Nontidal Wetlands

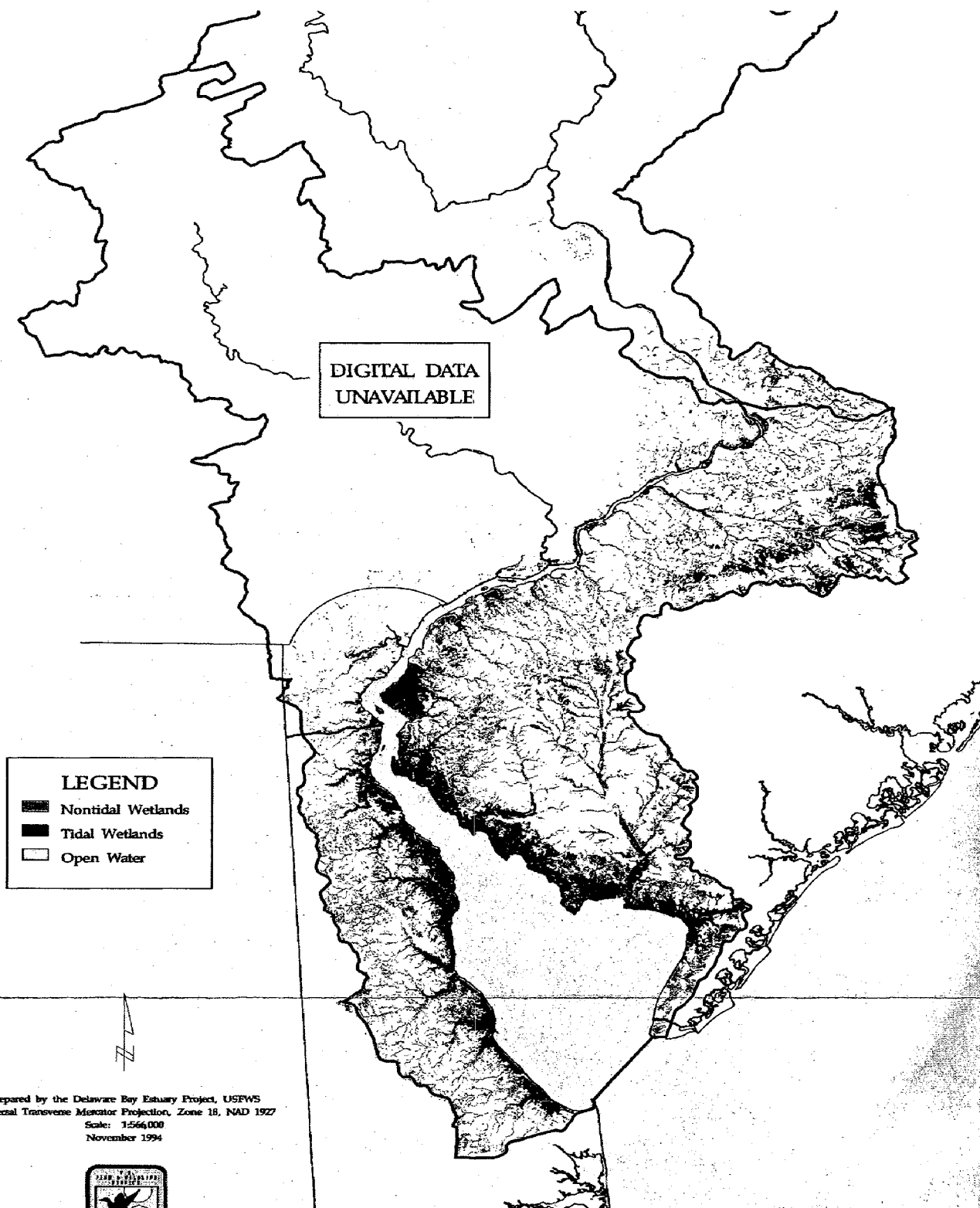


Figure 25. Tidal and nontidal wetlands.

However, state wetland management interests in this area can conflict. For example, the mosquito control technique, known as Open Marsh Water Management (OMWM), which is a substitute for the use of chemical insecticides, is currently being used wherever possible to reduce excessive mosquito populations. The creation of ponds and closed ditches, associated with the OMWM technique, in previously grid-ditched marshes restores surface water pools and pans, benefitting many estuarine fish and wildlife species. However, care must be taken, in using OMWM techniques, to not either excessively flood or dewater marsh surfaces. This can be harmful to many species, or negatively impact threatened and endangered species, such as the Short-eared Owl, which depends on higher marsh areas.

Coastal marshes have been negatively impacted by the aggressive encroachment of the common reed (*Phragmites australis*), which out-competes native marsh plants. In addition to being a fire hazard, *Phragmites* stands reduce the value of coastal marshes as wildlife habitats by decreasing available food, habitat diversity, and open water space. It is estimated that, in the State of Delaware, one-third of the tidal wetlands are infested with *Phragmites* (Philipp, 1994).

In recent decades, planning efforts have focused on the preservation of wetlands as open space, and, as a result, considerable public open space now exists within the Delaware Estuary. Public and state open lands within the region include John Hines National Wildlife Refuge (Tinicum) in Pennsylvania, and Bombay Hook and Prime Hook National Wildlife Refuges in Delaware, as well as many state wildlife management areas bordering the Estuary. In New Jersey, there is a long corridor of public lands along the bay shore from Salem to Cape May County, including the recent creation of the Cape May National Wildlife Refuge, which currently protects about 2,835 hectares (7,000 acres), and has a design target of 6,885 hectares (17,000 acres). A similar extensive corridor of protected land exists in Delaware, from Port Penn to Lewes, composed of state wildlife areas, federal refuges, and lands owned by conservation groups. Current trends include the protection of the upland edge of wetlands (borders which act as buffers from nonpoint source pollution and other impacts to wildlife) and the protection of wildlife habitat by private sector organizations, such as The Nature Conservancy.



BAYSHORE BEACHES AND MUDFLATS

Each May and June, the sandy beaches and intertidal mudflats, along the shorelines of the lower Delaware Bay in Delaware and New Jersey, host the second largest population of migrating shore birds in North America. These birds including the semipalmated sandpiper, ruddy turnstone, redknot, sanderling, and dunlin stop over at areas used by spawning horseshoe crabs, to feast on the crab eggs. Alterations in these areas could have catastrophic impacts on both the horseshoe crabs and the migratory birds which depend on them.

Shorebird concentration areas are at risk mainly from potential oil and chemical spills, from alterations to the beach habitat, including scrub/shrub and dune habitats, and from human disturbance.

Shorebird habitat is not limited to the months of May and June or to Bay beaches. Large numbers of a variety of species use the tidal marshes and intertidal mudflats during all seasons of the year. Wading birds (herons, egrets, and ibis) use the wetlands extensively as well. The Pea Patch Heronry, on the upper Bay, is the largest heronry in the northeastern states.

UPLANDS

Upland habitats are comparatively unregulated and unprotected. These habitats, particularly forested areas and successional meadows, are being fragmented because they are desirable for development and largely only regulated at the local level. As a result, populations of species dependent on unfragmented uplands have declined drastically. Small patches of forest are of much lower value to nesting forest birds than large tracts. Forested tracts, about 7,000 acres (3,000 hectares) or larger, are needed to ensure that Mid-Atlantic neotropical migrant songbird populations (those which migrate to the new world tropical regions in central and South America, e.g., wood thrush and scarlet tanager) can nest successfully. Species which depend on large tracts of forest interior during the nesting season cannot "make do" with smaller isolated tracts. To stop the decline of forest-dependent species, large forest preserves of thousands of hectares should be set aside (Robbins *et al.*, 1989).

The sandy beaches and intertidal mudflats of the Delaware Estuary host the second largest population of migrating shore birds in North America each May and June.

G. Living Resources

Living resources, the plants and animals living in, on, and around the Delaware Estuary are the component of the system which are most likely to be seen and enjoyed by people. Living resources of the Estuary range from microscopic plankton, to oysters and crabs, to minnows and sturgeon, to ducks, and even to humpback whales. All naturally occurring species of plants and animals are part of the complex ecology of the Estuary and are part of an integrated food chain, or more precisely, a food web.

The species composition of the communities residing in the Delaware Estuary is important in the ecological functioning of these communities. Most species are not valued for commercial, recreational, or aesthetic reasons; but all species are important as part of the food web which contributes to the survival and production of other species, including economically important ones. Some species are referred to as key species in that regard.

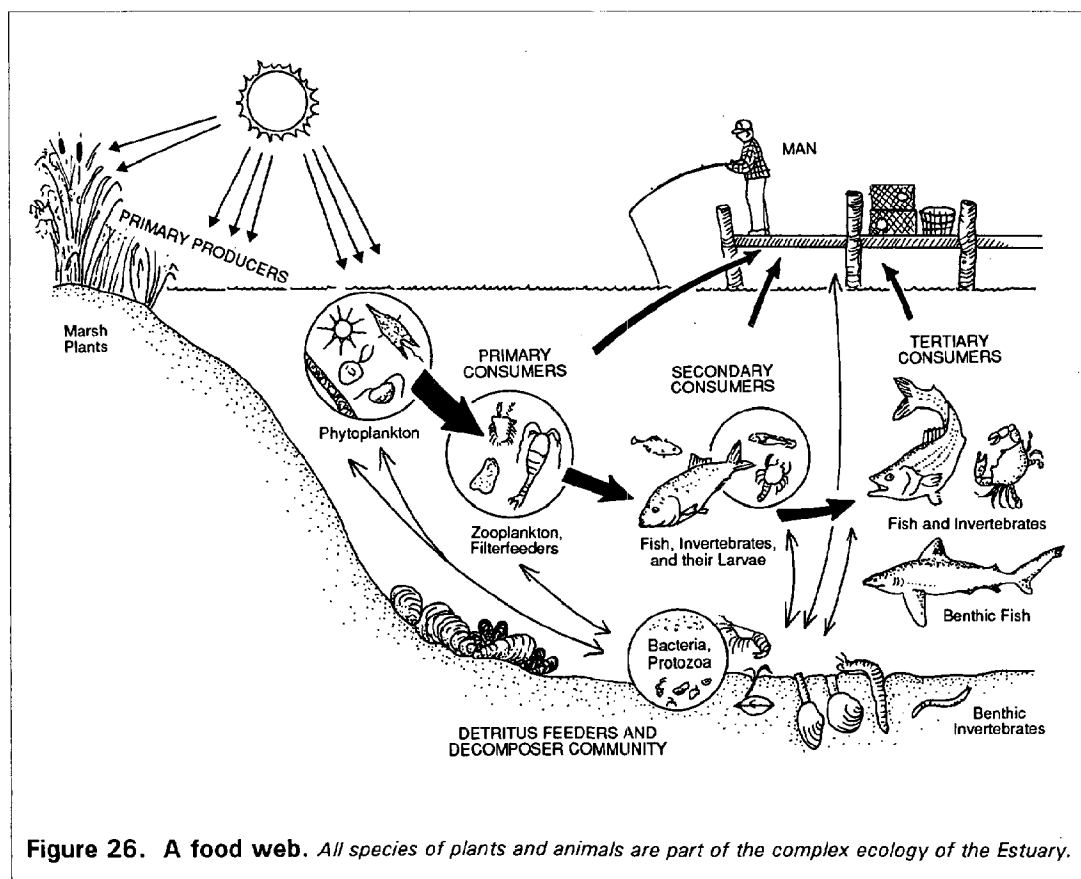









Figure 26. A food web. All species of plants and animals are part of the complex ecology of the Estuary.



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For the purposes of the Plan, factors to be considered in determining the ecological importance of species or groups (guilds) of species are that they:

	Produce significant quantities of organic matter for the food web;
	Are food for other resources in the Estuary;
	Significantly control or modify the population levels or seasonal dynamics of other plants and animals within the Estuary by grazing, predation, or disturbance;
	Control or modify some process (e.g., benthic nutrient regeneration) that in turn influences other resources;
	Significantly contribute to commercial or recreational landings;
	Are classified as endangered, threatened, or protected by federal or state agencies; and
	Are a shared resource with other estuaries or even other hemispheres, as in the case of migratory birds.

Often key species are only found in specialized habitat types, and the "important habitats" listed in this document support many key Delaware Estuary species. The habitat requirements of key species are detailed in a companion document to this Plan, the Priority Species Report of the Delaware Estuary Program.

PLANKTON

Minute floating plants, or phytoplankton, are the dominant source of organic matter for most of the Delaware Estuary biological communities. They form the base of the food web. The phytoplankton in the Estuary are relatively healthy despite high nutrient concentrations and turbidity. Diatoms remain the dominant type of phytoplankton in the important winter-spring bloom period (Marshall, 1991). Shifts in phytoplankton species composition may have a greater impact on the overall trophic

structure of the system than changes in phytoplankton abundance.

As expected, the lower bay portion of the Estuary is dominated by marine and estuarine forms while freshwater species dominate the freshwater tidal upper regions. Spring blooms dominated by diatoms shift to flagellate communities in the summer and fall (Marshall, 1991). Phytoplankton biomass and production are spatially and temporally variable and exhibit seasonal cycles similar to those in other temperate estuaries (Pennock and Sharp, 1986). In the past 10 years, phytoplankton production appears to be increasing in the Delaware Estuary, especially in the Lower Zone (Sharp *et al.*, 1994). Trends are not as clear for the transition or tidal river regions.

The primary consumers of phytoplankton in the Delaware Estuary are minute animals, called zooplankton. Copepods dominate the zooplankton and may directly consume a high percentage of the phytoplankton primary production in the lower Bay (Herman and Hargreaves, 1988).

Marine mysids, small shrimp-like crustaceans, also play an important role in the Delaware Estuary food web. While mysids are often associated with the bottom, they regularly comprise part of the zooplankton. At times they can be very abundant and a significant food source for juvenile fish (Herman and Hargreaves, 1988).

BENTHIC COMMUNITIES

The organisms of the bottom-dwelling, or benthic communities, are important consumers and provide a link between primary producers and higher trophic levels. It has been suggested by several studies that the standing stock and diversity of floral and faunal benthos in the higher salinity, hydrographically dynamic portions of the Delaware Bay may be low compared to other east coast estuaries (Hargreaves and Kraeuter, 1989). Pollution does not appear to be a major factor in the reduced abundance (Haskin *et al.*, 1984). However, loss of hard substrate habitat from the decline in oyster reefs results in highly scoured coarse sand, which is unstable for benthic communities.

The annual production of the healthy blue crab fishery in the Delaware Estuary is variable, but no less predictable than in other nearby producing areas (Haskin *et al.*, 1984). Water quality,

except for heat-related, mid-summer anoxic (little or no oxygen) conditions in tributaries, which are scattered and rare, does not appear to be affecting these populations (Hargreaves and Kraeuter, 1989).

The Delaware Bay horseshoe crab population is the largest in the world and a key species in the Estuary. In addition to providing food for migrating shorebirds, the horseshoe crab is important economically, as bait and in the manufacture of a product which is used in medical testing of drugs and surgical implants.

The Delaware Estuary is unique in the region because its saline portion (except in the upper Estuary) lacks seagrass meadows (Hargreaves and Kraeuter, 1989). They may have existed at one time, because eel grass (*Zostera marina*) was once present in Cape May Harbor and in the backwaters of Cape May County, but

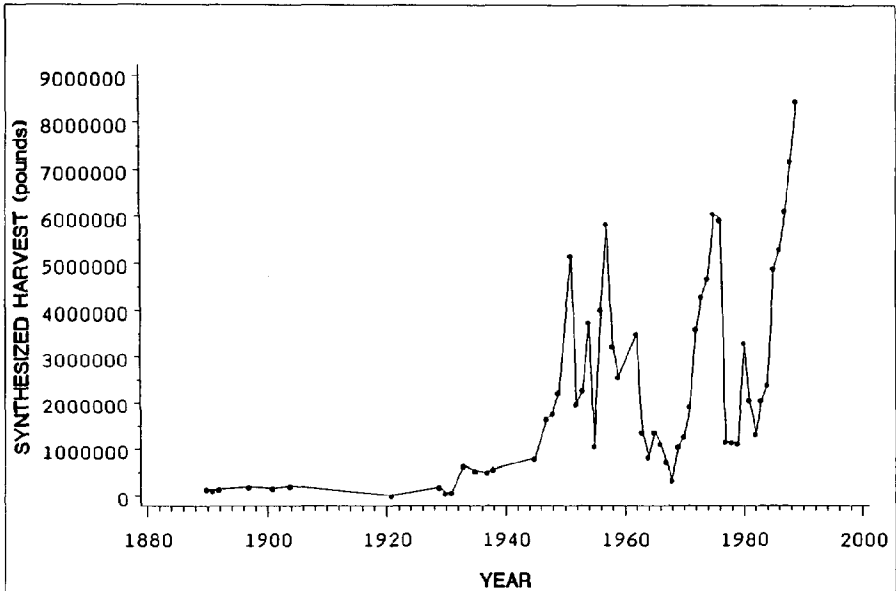


Figure 27. Synthesized estuary-specific blue crab harvest. Source: "An Assessment of Fisheries Landings Records in the Delaware River Estuary." Prepared by K.A. Killam and Dr. W.A. Richkus, September 1992.



Figure 28. "The Delaware Estuary horseshoe crab population is the largest in the world and a key species in the Estuary."

Brush (1994) found no evidence of *Zostera* (in the form of seed), in recent decades, in cores taken throughout the Estuary.

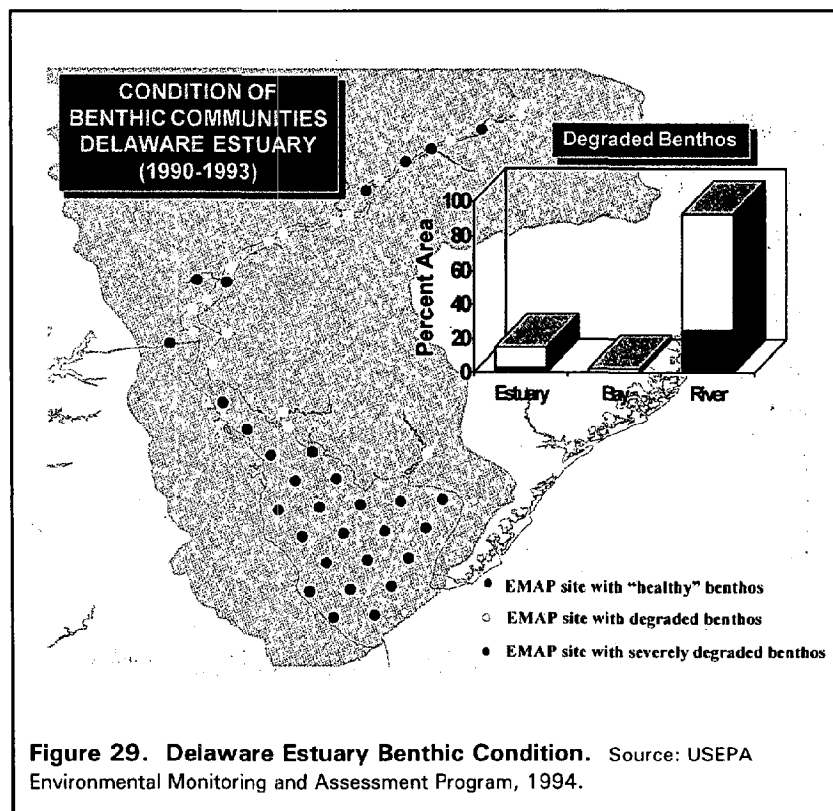
Benthic organisms are excellent indicators of the overall ecological health of the Estuary since they are sensitive to pollution exposures. Because benthic organisms stay in one place, they are affected by the pollution at that site over the long-term. They are a major link in the food chain between primary producers and higher trophic levels, including fish, shellfish, birds, and wildlife.

USEPA's Environmental Monitoring and Assessment Program (EMAP) reviewed estuaries in the northeast U.S. and collected environmental data in the Delaware Estuary from 1990 through 1993. An analysis of the EMAP data (Paul, *et al.*, 1994) indicates the following benthic community conditions, as defined by the EMAP benthic index (See Figure 30):

⇒ Much (93% of area) of the tidal river from the vicinity of the C&D Canal northward to Trenton, New Jersey, has benthic communities classified as either degraded (68% of area) or severely degraded (25% of area).

⇒ The Bay's (south of C&D Canal) benthic community is generally healthy, with only two percent of its area classified as degraded, and none classified as severely degraded.

For the area of the tidal river which is classified as degraded or severely degraded, the degraded benthos appear to be associated with the presence of metals,



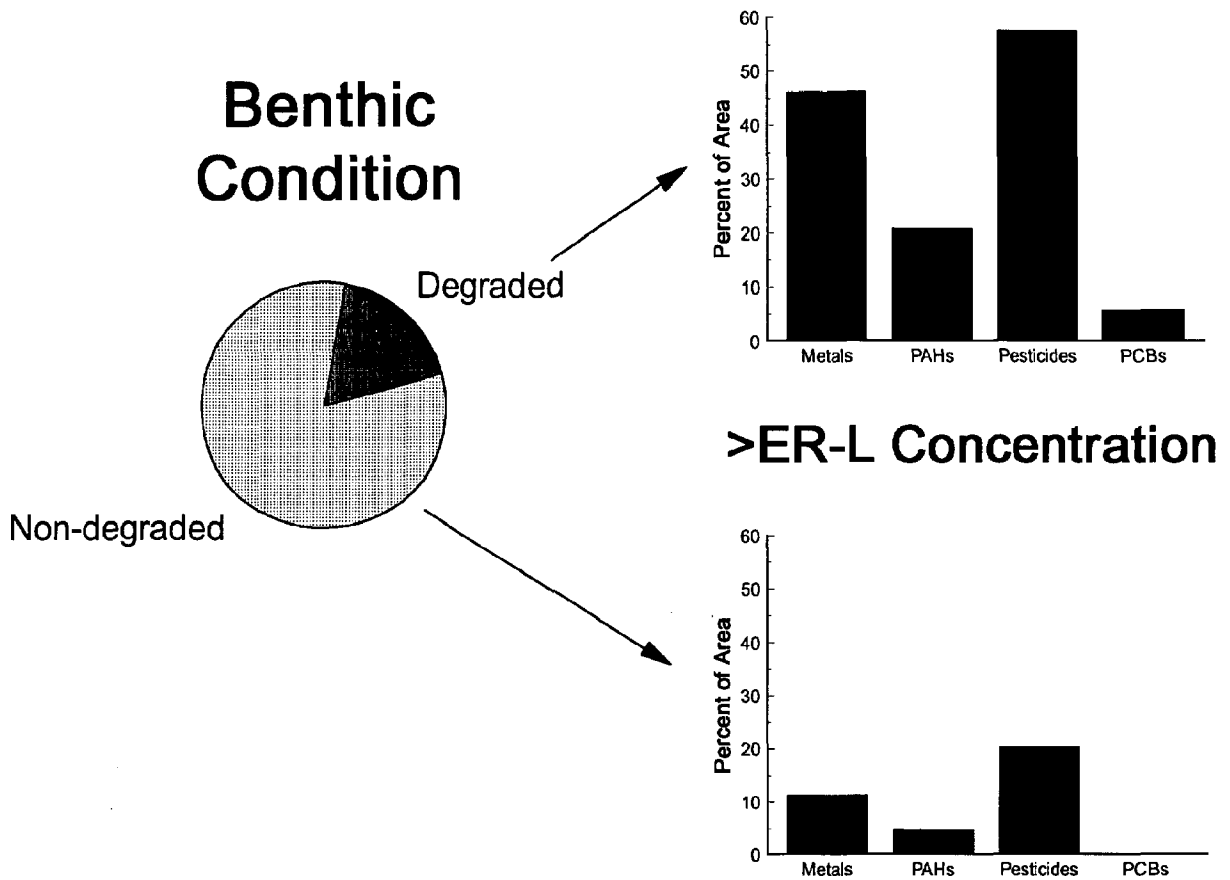


Figure 30. Condition of benthic communities, Delaware Estuary, 1990-1993.

PAHs, pesticides, and PCBs. As shown in Figure 30, a high percentage of the area classified as degraded also exceeds the concentration level in the bottom sediments of the river at which biological effects begin to occur (known as the ER-L) for those pollutants. This seems to indicate that metals, PAHs, pesticides, and PCBs are affecting the health of the benthos, although it is recognized that other factors may be involved. Additional discussion of the role of metals and organics can be found in the Toxic Substances section of this chapter.

FISH

Over 200 fish species, both residents and migrants, use the Delaware Estuary. The residents include freshwater and salt water species, but some of the estuarine residents, such as white perch, have a broad range of salinity tolerances. Resident species

are those that for the most part conduct all aspects of their life history within the confines of the Estuary, seldom moving far into the coastal waters around the Estuary mouth. The ocean migrants include both warm and cool water species. A number are anadromous, living in ocean waters yet migrating to fresh water to breed, such as the herrings and shad. One species, the American eel, is catadromous, living in fresh or brackish waters yet breeding in the ocean. The migrant species have a strong affinity for an oceanic existence as adults, but are usually dependent

on the Estuary as a spawning ground and/or nursery. Some oceanic migrants may use the Estuary only as a feeding ground.

Within the Delaware Estuary there are two primary nursery areas: wetlands, including the shallow marsh fringe areas and mudflats, and the low salinity areas at the head of the Estuary. This low

Over 200 fish species, both residents and migrants, use the Delaware Estuary.

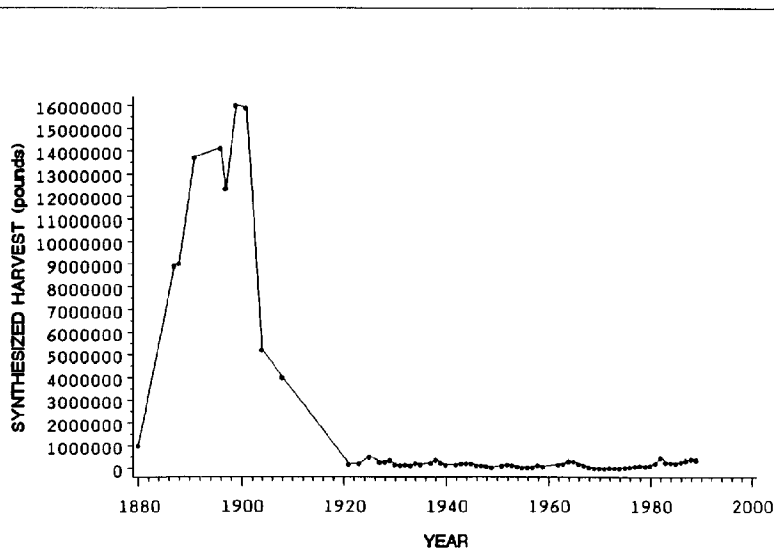


Figure 31. Synthesized estuary-specific American shad harvest.
Source: "An Assessment of Fisheries Landings Records in the Delaware River Estuary." Prepared by K.A. Killam and Dr. W.A. Richkus, September 1992.



salinity open-water portion is a region of exceptional value to fish. This region receives fish eggs, larvae, and young from freshwater spawners, semi-anadromous and anadromous fish, estuarine spawners, and even some larvae spawned in the Lower Zone and ocean. The distribution of juvenile fishes within primary nursery areas is related to a variety of factors, including temperature, salinity, turbidity, food availability, and predation pressure (O'Herron *et al.*, 1994).

Priority species in the Delaware Estuary include various sharks, skates and rays, shortnose and Atlantic sturgeon, American eel, blueback herring, alewife, American shad, Atlantic menhaden, common carp, various catfish, white perch, striped bass, bluefish, scup, weakfish, spot, Atlantic croaker, black drum, and various flounder species (Maiden, 1977; O'Herron *et al.*, 1994). Many of these fish are important to recreational and/or commercial fisheries, and also play an integral role in the Delaware Estuary food web, as consumers of plankton and benthos.

The impacts of man (fishing mortality and environmental perturbation) are often difficult to discretely identify and sort out from natural factors, but both, in combination or separately, have been responsible for declines in various fish stocks (Daiber, 1988; Frithsen, Killam, and Young, 1992; Kiry, 1974; McHugh, 1966; and Scheier and Kiry, 1973). Since many of the commercially and recreationally important species are migratory in nature and spend part of their time outside of the Estuary, overfishing and habitat loss outside of the Estuary also affect population levels.

Up until the 1960s, menhaden were the most economically important species in the Estuary, but, today, weakfish hold this

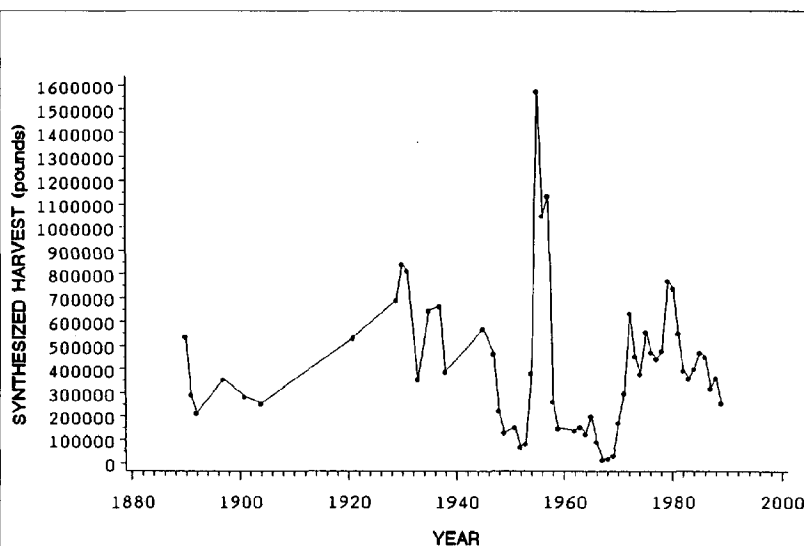


Figure 32. Synthesized estuary-specific weakfish harvest. Source: "An Assessment of Fisheries Landings Records in the Delaware River Estuary." Prepared by K.A. Killam and Dr. W.A. Richkus, September 1992.

position, partly because of their value in recreational fisheries. The recently declining trends in total weight landed and average size in the recreational fishery are considered indicative of an overall decline in the Atlantic weakfish stock (Weakfish Review Team, 1990). Anadromous fish, including American shad, Atlantic sturgeon, and the alewife have also declined substantially since the 19th century, but numbers of shad have particularly improved in recent years. Juvenile striped bass numbers have also been significantly increasing in the last 10 years. Factors that may contribute to these trends are improvements in water quality (e.g., shad) and restrictions placed on harvest (e.g., striped bass).

Trends in commercial landing records in the last century indicate that the prominent upriver fisheries have been replaced by down-bay marine and estuarine dependent fisheries, including weakfish, summer flounder, spot, bluefish, and menhaden (Price and Beck, 1988). Fish populations are influenced by climatic and human activities, including both recreational and commercial overharvesting (Frithsen *et al.*, 1991). In the Delaware Estuary, changes in abundance of anadromous species have been historically linked with a decline of available spawning habitat, due to obstructions in the waterways (dams, pollution blocks) which prevent access to spawning beds, overall water quality, and overfishing. Destruction and alteration of wetland habitats have decreased available nursery areas for juvenile fish development, and recreational fishing pressure has steadily increased (Price and Beck, 1984). There are at least 31 species which are commercially harvested from the Estuary. The value of the Delaware Estuary commercial fin fishery was about \$1.4 million in 1990.

Trends in commercial landing records in the last century indicate that the prominent upriver fisheries have been replaced by down-bay marine and estuarine dependent fisheries

BIRDS

The Estuary wetlands are an important resource for breeding black duck, a declining species which feeds on submerged vegetation and invertebrates. Overwintering waterfowl, many which nest in prairie potholes and arctic tundra to the far west and north of the Estuary, often congregate in large numbers along both shores of the lower Bay, where saline water remains ice-free longer than in areas to the north. Among the most prevalent species are dabblers such as black duck, mallard, pintail, and green-winged teal and divers like red-breasted merganser, ruddy duck, and scoters. Tributaries and impoundments are particularly important to waterfowl. Snow geese can be locally abundant in salt and



brackish marshes, where large flocks can consume all the vegetation in certain areas, a condition known as an "eat out." Snow geese populations have risen dramatically since the 1960s, while migratory Canada geese numbers have declined in recent years. Game species are an important source of recreation and food in the Estuary region, and hunting contributes to the economy of rural areas.

Predatory birds occur in most of the Delaware Estuary's ecological niches. Northern harriers nest and overwinter in the extensive salt marshes of the lower Bay, where they are a hallmark species. Red-shouldered hawks and barred owls nest and hunt in the region's extensive hardwood swamps, while great horned owls, red-tailed hawks, and Cooper's hawks can be found in upland forests, forest edges, and woodlots. Osprey, peregrine falcons, and bald eagles are all found nesting along the shores of the Delaware. Migrating raptor species, 15 regularly occurring hawks and eagles, and 4 owl species, appear in both spring and fall along both shores of the Delaware Estuary. In autumn they often concentrate in spectacular numbers at the southern tip of the Cape May peninsula, an annual event which draws thousands of birders to the area. Many of these hawks, particularly falcons, head directly over the Bay toward Cape Henlopen, while others head northwest along the Jersey bayshore to points where the water crossing is narrower. Up to 54 percent of the raptors counted at Cape May may subsequently fly around the Bay, and use Estuary habitats for roosting and feeding (Sutton *et al.*, 1991). Neotropical migrant landbirds follow this same route as well, and Estuary upland forests, particularly the upland edge of the wetlands, host large numbers of passerine in fall and spring. In addition, many neotropical landbird species nest in the Delaware Estuary's varied habitats.

As mentioned earlier, the lower Delaware River Estuary is a major staging area for migrant shorebirds, which arrive in late May, many directly from South America, to gorge on the horseshoe crab eggs. During feeding, the shorebirds can gain up to 50 percent of their body weight in fat. This helps fuel the next leg of their migration to the arctic, flights which may include non-stop distances as long as 4,827 kilometers (3,000 miles). These birds migrate from one seasonally abundant food source to another, and large numbers are concentrated at these points. It has been estimated that as many as 70 percent of the North American population of red knot uses the Delaware Bay at one time (Clark *et al.*, 1993). This is a remarkable fact, but underscores the bird's

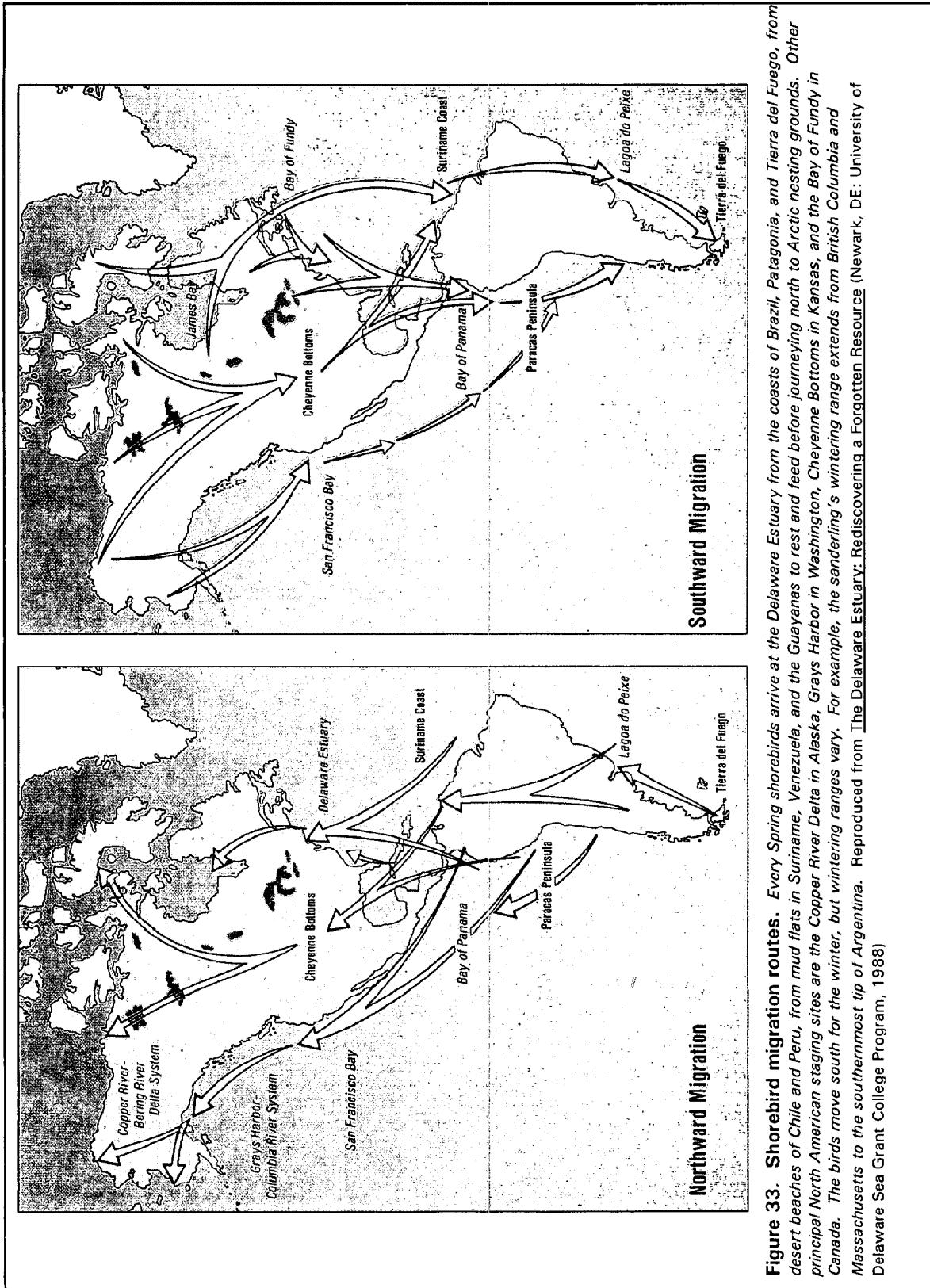


Figure 33. Shorebird migration routes. Every Spring shorebirds arrive at the Delaware Estuary from the coasts of Brazil, Patagonia, and Tierra del Fuego, from desert beaches of Chile and Peru, from mud flats in Suriname, Venezuela, and the Guayanas to rest and feed before journeying north to Arctic nesting grounds. Other principal North American staging sites are the Copper River Delta in Alaska, Grays Harbor in Washington, Cheyenne Bottoms in Kansas, and the Bay of Fundy in Canada. The birds move south for the winter, but wintering ranges vary. For example, the sanderling's wintering range extends from British Columbia and Massachusetts to the southernmost tip of Argentina. Reproduced from *The Delaware Estuary: Rediscovering a Forgotten Resource* (Newark, DE: University of Delaware Sea Grant College Program, 1988)



potential vulnerability to oil spills and other environmental disasters. Another threat to these significant shorebird concentrations might come from the potential overharvesting of horseshoe crabs for crab, lobster, and eel bait.

Principal factors contributing to trends in bird populations in the Delaware Estuary include natural fluctuations, hunting pressure throughout their range, habitat alteration and degradation throughout their range, and chemical contamination. Forest fragmentation and habitat alteration/degradation have been persistent problems associated with development pressures (Frithsen *et al.*, 1991). Contamination by organochlorine pesticides, particularly DDT and metabolites such as DDE, continue to influence reproductive ability of some raptor species which have experienced severe historical population declines (Niles *et al.*, 1991). Nineteenth and early twentieth century market gunning led to severe declines in waterfowl and shorebird numbers.

H. Summary

The Delaware Estuary has exhibited a dramatic recovery in water quality, especially in oxygen levels, compared to 20 years ago. This is a result of wastewater treatment facility construction and, in part, the removal of industrial discharges due to mandates of the federal Clean Water Act. However, the "recovery" of the Estuary has been far from complete, and problems associated with development, water supply, habitat loss, and the persistence of toxic substances continue. Many potential problems have not been measured adequately due to lack of baseline data (e.g., habitat/wildlife) or the scientific inability to perform quality testing (e.g., metals and organics).

The techniques to routinely measure toxic substances were simply not available 20 years ago; therefore, it is virtually impossible to make comparisons between those measured today with historical levels of toxic substances. For this reason, it is premature to state that the chemical environment of the Delaware Estuary has substantially improved, and the known current levels of toxic substances dictate that there is still much work to be accomplished. The improvements in water quality relating to oxygen and nutrients were relatively easy compared to current efforts to lower organic and metal inputs to the Estuary from both

Today, problems associated with development, water supply, habitat loss, and the persistence of toxic substances continue.

point and nonpoint sources. At this stage in Estuary management, additional improvements will require greater efforts.

The Delaware Estuary represents the edge of many species' habitat ranges, creating significant biodiversity; but small changes in climate or water temperature during crucial spawning or migratory periods may alter recruitment from year-to-year (Price and Beck, 1988). The Upper Zone (tidal river) reflects the greatest impact of water quality problems, while the Lower Zone is relatively unaffected by pollution (Hargreaves and Kraeuter, 1989).

Water quality problems such as toxic substances in the Upper Zone may have a disproportionately large impact on critical life history stages of important species (e.g., anadromous fish). In addition, the Estuary-wide interactive impacts of multiple cooling structures, combined sewer discharges, water diversions, and other large scale manipulations of water flow on the food web and directly on the survival of fish and shellfish may need to be addressed (Hargreaves and Kraeuter, 1989).

Population growth, and the demand for new housing, shopping centers, and places of employment, is projected to continue throughout the region between now and the year 2020, with an overall projected population increase of 14 percent. Coastal species, habitats, and ecosystems, as well as water supply, are under considerable stress from development pressure and are becoming less resilient as human population densities increase.

In comparing current habitat and wildlife status and trends to those of the past, known gains in snow geese and striped bass, for example, are negatively offset by serious declines in weakfish and black duck populations. In both declines, cause and effect are not well understood and/or not enough information is available to managers. What is known is that while wetlands loss rates have clearly slowed, uplands are being lost as wildlife habitat and wetland buffers at an alarmingly increasing rate. As habitat is lost due to population growth and movement away from urban areas, the potential loss of species diversity becomes another issue of concern, one which applies to the living resources of both the land and the waters of the Estuary.

The increase in economic pressures on the habitats of the Delaware Estuary dictates that remaining uplands, wetlands, and living resources will require extra protection efforts in the future. Increased population and development also directly impact water

The increase in economic pressures on the habitats of the Delaware Estuary dictates that remaining uplands, wetlands, and living resources will require extra protection efforts in the future.



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use; increasing water demands have resulted in periodic water supply shortages and regional groundwater overdrafts.

Although the next steps towards the recovery of the Estuary may not be as readily identifiable or as easily implemented as those accomplished to date, there are clear trends which require action. These trends are well documented in the areas of toxic substances, habitat and living resources, and land use, and require both immediate and long-term coordinated efforts to reverse current problems and to continue to aid in the recovery of the Estuary. The action plans which follow are based on scientific evidence and are an important beginning towards the protection of the natural resources of the region and towards the realization of a sustainable economy for the residents of the Estuary region—one based upon the unique, varied, and valuable living resources of the Delaware Estuary.

INTRODUCTION TO ACTION PLANS

The following Action Plans covering Land Management, Water Use Management, Habitat and Living Resources, Toxics, Education and Involvement, Monitoring, and Regional Information Management Service describe 77 specific actions to address problems confronting the Delaware Estuary.

These actions were developed over a three year period, in a consensus based effort, involving task forces for each of the priority areas, hundreds of Management Conference participants (See Appendix C), and ideas from many sources: from reactions to our preliminary plan (Preliminary Conservation and Management Plan or PCMP) in 1992, from people who spoke up at numerous workshops and conferences, and from people who wrote to us. All ideas were evaluated using the following Program objectives as a guide:

DELAWARE ESTUARY PROGRAM OBJECTIVES



To restore population levels of harvestable species of finfish and invertebrate species to levels that will support sustainable recreational and commercial fisheries.



To restore or maintain populations of birds dependent on the Delaware Estuary to levels deemed attainable by comprehensive analysis.



To restore or maintain populations of estuarine-dependent amphibians, reptiles, and mammals to levels deemed attainable by comprehensive analysis of natural populations.



To maintain or restore an assemblage of organisms and their habitat throughout the Delaware Estuary and tidal wetlands that contribute to the ecological diversity, stability, productivity, and aesthetic appeal of the region.



To preserve acreage and enhance quality of shoreline and littoral habitat to sustain a balanced natural system. To restore and maintain the physical and environmental conditions necessary to achieve target levels of estuarine species.



To restore habitat diversity (e.g., mixture, array and pattern of wetland types), values, and functions of tidal and non-tidal wetlands to levels commonly found in the 1920s (prior to parallel grid ditching and large scale drainage), done in a balanced consideration of today's socioeconomic needs.



To assess air quality impacts on estuarine resources and support programs that reduce these impacts.



To achieve water quality that will maintain and enhance estuarine use designations consistent with the Clean Water Act.



To ensure an adequate supply of fresh water to the Estuary to maintain habitats, distribution of salinity, and human population in 2020.



To optimize sediment quantity and quality in a manner that maintains or enhances a balanced indigenous estuarine biota and habitat.



To promote and enhance ample and high quality water-based and associated terrestrial-based recreational opportunities with sustained availability for public use.



To develop programs and actions that will be mutually beneficial to both the economy and environment of the estuary, by forging a partnership with industry, commerce, and local governments in pursuit of continued economic vitality of the region, while enhancing and preserving its living and natural resources.



To preserve and enhance cultural resources and traditions in the estuary region, and promote their accessibility to the public.



To promote pollution prevention technologies and strategies that protect estuarine resources (e.g., from catastrophic spills, point sources, and nonpoint sources).

INTRODUCTION TO ACTION PLANS

The actions were then reviewed by each Delaware Estuary Management Conference Committee (the Scientific and Technical Advisory Committee, the Local Government Committee, the Financial Planning Committee, and the Citizens Advisory Committee) and by various stakeholder groups outside of the Management Conference structure representing watermen, pleasure boaters, educators, environmental organizations, developers, utilities, agriculture, ports, and the petrochemical industry. All comments were addressed by the Program's Management Committee and appropriate revisions were made. The Policy Committee then authorized the release of this Plan for broad public review.

The proposed actions are listed by title in Table 3. In the following chapters, each proposed action is described including:



Rationale for the action and how it will be accomplished;



Identification of responsible entities, both lead entity and partners;



Initiation timeframe: short-term (within two years); mid-term (three to five years); and long-term (six years or longer);



Resource estimate; and



Measure of success.

Some of the actions list the Delaware Estuary Council or Delaware Estuary Foundation as a responsible entity. The Council and Foundation are part of the proposed post-CCMP implementation structure which is described in Chapter XI.



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CHAPTER III: Land Management Action Plan

The individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in the community, but his ethics prompt him also to cooperate (perhaps in order that there may be a place to compete for). The land ethic simply enlarges the boundaries of the community to include soils, water, plants and animals or, collectively: the land. Aldo Leopold, Land Ethic, 1949.

The Delaware Estuary Program, through this Plan, joins the effort to change the land ethic that has guided us for generations. This change would result in our taking a broader view of environmental protection—metaphorically enlarging the boundaries of our communities—to ensure that our irreplaceable natural resources are protected for the future. We must consider the Estuary as an ecosystem and ourselves as part of an Estuary-wide community, motivated by what DeWitt John (1993) has called "civic environmentalism," through which we will cooperatively address issues that threaten to undermine the Estuary's ecological health and the quality of life of the communities that rely on it.

As we consider the protection of the Estuary's ecosystem and how to address the problems that affect it, we must focus on its entire watershed. When we design approaches to protect the natural resources of the Estuary watershed, it is evident that *land use* must figure prominently in our plans. Where we put office buildings, highways, parking lots, houses, stores, farms, and parks has important ramifications for water quality and quantity, habitat for fish, birds, and mammals, and access to the water's edge for recreation.

Land use traditionally has been a local issue in the Estuary watershed, and, even at the local level, it is an exceptionally sensitive issue. What is needed today to conserve natural resources and protect environmental quality, however, is a regional approach to land use. We recognize that there are many barriers and obstacles to such an approach, but we also recognize that there are ways to overcome these barriers and obstacles.

What is needed today to stem continued environmental degradation is a regional approach to land use.



First, we must make people throughout the Estuary watershed—state and local elected officials, individual residents, decision-makers in business and industry, and others—aware that wise planning, innovative technology, and state-of-the-art open space zoning offer an opportunity to rethink conventional practices and address community interests in both conservation and land equity. Next, we must motivate them to make decisions and take action with a regional watershed-wide perspective, imparting to them a broad-based land ethic and a sense of civic environmentalism and demonstrating that environmental protection can have significant fiscal benefits. Finally, we must offer creative solutions, that not only will have a positive effect on environmental protection, but also on quality of life in the watershed's communities.

This chapter includes 18 actions to promote a regional, watershed approach to land use by offering support for environmentally-sound land use practices, filling gaps in existing land use laws and regulations, and dramatically changing the way we think about land use and protection of the Delaware Estuary. Some of these actions can be undertaken immediately, while others will require legislative action and the cultivation of significant levels of public support. All of the recommended actions, however, will advance the goal of forging a new land ethic that will guide the way we think about and treat the Delaware Estuary watershed.

The recommended actions will advance the goal of forging a new land ethic that will guide the way we think about and treat the Delaware Estuary watershed.

A. Why Land Use is a Concern of the Estuary Program

In the past, cities, towns, and villages in the Delaware Estuary region were compact and densely populated. Examples include Philadelphia, a major city; Haddonfield, a moderate-sized town; and Smyrna, a village. Although these communities have negative effects on the watershed's ecology, they are relatively more efficient and less damaging to the environment than the sprawl development that has occurred in the last several decades, which consumes much more land to accommodate fewer people and, therefore, has more far-reaching effects on both the community and the ecosystem.

Specific evidence of these effects include:



Most townships and counties have adopted zoning ordinances, principally to set rules for the orderly conversion of natural lands into developed properties. Communities who have relied on this

conventional "cookie-cutter" approach to zoning often find that parcel by parcel they become blanketed with "wall to wall development" (Arendt, 1994);



As land is transformed from natural cover to impervious surfaces, increased loadings of pollutant-laden stormwater and reduced absorption and filtration occur. This in turn affects stream hydrology with more water flowing to streams during storm events and less water available for groundwater recharge and maintenance of stream base flows;



Low density suburban development requires that people drive everywhere they go, creating highway congestion and air pollution. Air pollutants eventually end up in the Estuary, falling with rain;



With development spread out over large areas, the cost of constructing and maintaining infrastructure, such as highways and sewer systems, is significantly greater than it would have been if development had been concentrated (New Jersey Office of State Planning, 1992);



Inefficient land management fragments natural habitat, creating small, less ecologically valuable parcels (Robinson, Yurlina, and Handel, 1994);



Natural vistas are impaired;

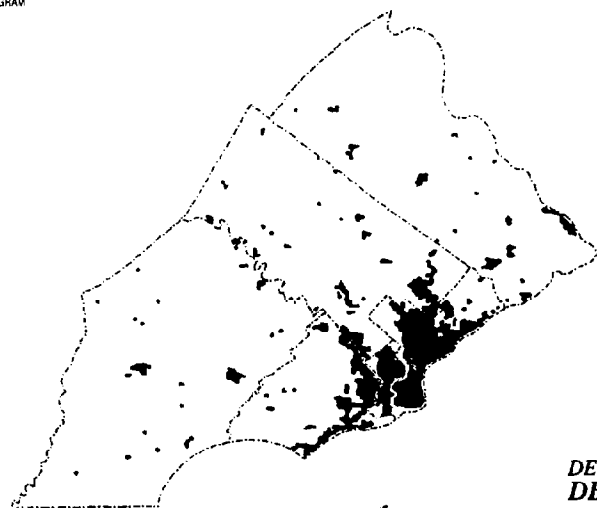


Public access to natural settings, including parks and the Estuary waterfront, is diminished by development that does not take open space protection into account (Arendt, 1994); and

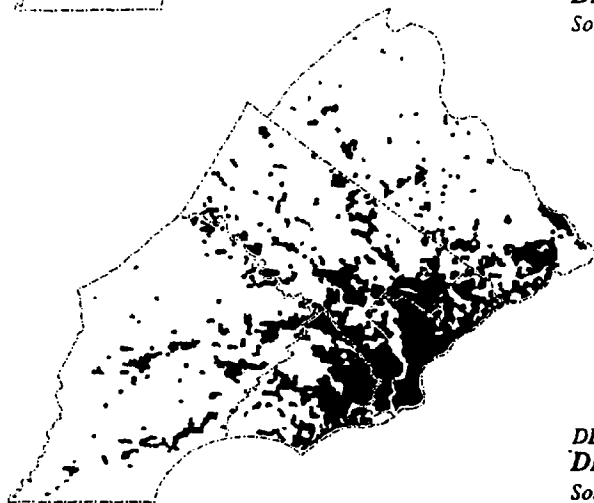


Valuable agricultural land, which is often the easiest land to develop, is consumed. Important habitat and groundwater recharge areas are lost and, as farmland is fragmented and surrounded by development, agriculture cannot survive (Smith, 1994).

WHY DO WE NEED A REGIONAL APPROACH TO OPEN SPACE IN SOUTHEASTERN PENNSYLVANIA?



DEVELOPED LAND
DELAWARE VALLEY, 1930
Source: U. of Pa., 1970, CPA, 1992



DEVELOPED LAND
DELAWARE VALLEY, 1960
Source: U. of Pa., 1970, CPA, 1992










DEVELOPED LAND
DELAWARE VALLEY, 1990
Source: NPS, DVRPC, 1991, CPA, 1992

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Figure 34. Why do we need a Regional Approach to Open Space, Toni Seymour, AICP: Regional Institute of the City Parks Association (1992); University of Pennsylvania (1970); The National Park Service and the Delaware Valley Regional Planning Commission (1990).

Continuation of current trends in sprawl development in the future does not bode well for the health of the Delaware Estuary, its natural resources, or its cities, towns, and villages (See Figure 34). But current trends do not have to continue. There are creative new approaches to managing growth that have the potential to ensure that new development does not undermine our efforts to protect our environment. This is what we mean by sustainable development. These approaches, however, are relatively untried and need to be actively promoted if they are to change the status quo.

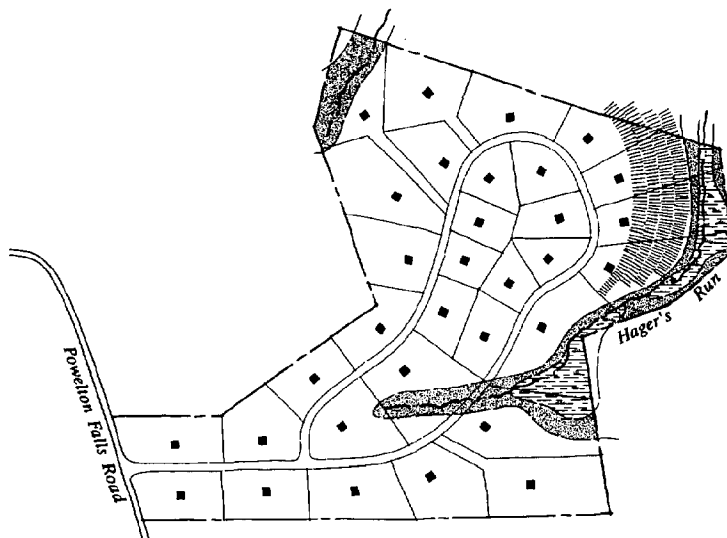
The Delaware Estuary Program recognizes that growth and development are important to Estuary watershed communities and that they are not necessarily incompatible with a "greener vision" that conserves those natural lands and special places that give our communities their distinctive character. Accordingly, this Plan attempts to highlight practical alternatives to conventional zoning, wastewater treatment, and municipal-specific decision-making that offer an opportunity to:

-  Link green spaces within and between communities.
-  Conserve important terrestrial habitat.
-  Reduce stormwater loadings by slowing runoff velocities and providing for increased infiltration and natural filtration.
-  Increase stream shading.
-  Increase flexibility for wastewater reclamation and reuse.
-  Reduce maintenance costs.
-  Reduce infrastructure and engineering costs.

One example of innovative site planning is depicted in Figure 35. This figure compares and contrasts conventional zoning and open space zoning for a specific site. Both plans yield the same number of units.

The threats to the Estuary posed by sprawl development, and the potential benefits of successfully implementing creative, sustainable approaches to growth, are compelling reasons for

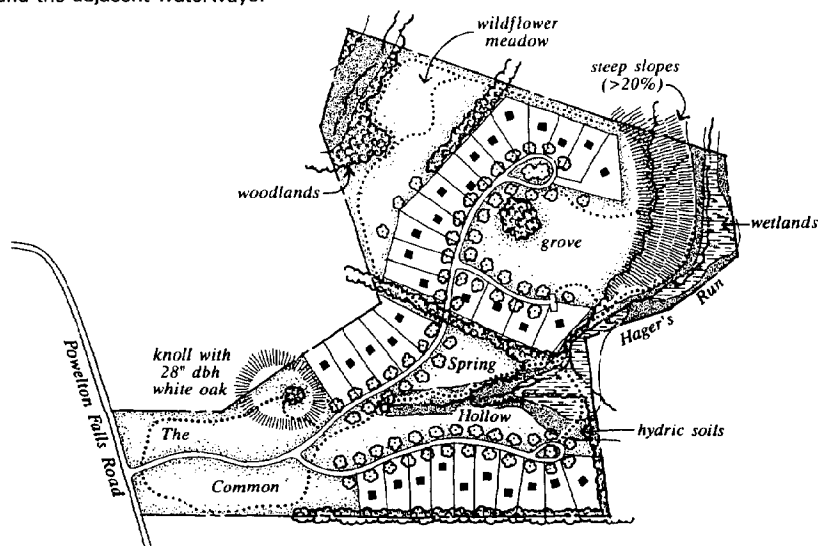
A. A conventional site plan



The site plan above (A) shows a traditional approach to placement of lots and streets as permitted under conventional zoning ordinances in many Delaware Estuary region municipalities. This approach spreads development over virtually the entire site and requires that infrastructure (streets and sewer lines) be extended to serve this area. Natural systems have been fragmented or destroyed.

The site plan below (B) shows a development approach on the same piece of land. It has the same number of house lots, but these cover substantially less area and more open space is protected. This open space is easily accessible to neighborhood residents and offers a system of trails, protects attractive views, and will continue to serve important environmental functions—including the protection of water quality through stream buffers and the provision of an unbroken forest canopy for wildlife. This site plan requires far less infrastructure than the traditional approach—which means lower costs for construction and maintenance. It also has less impervious surface area—which means that there will be less runoff discharged into the storm sewer system and the adjacent waterways.

B. An innovative site plan



Creative site design can protect habitat and water quality without reducing the number of houses built on a site.

Figure 35. Creative site design can protect habitat and water quality without reducing the number of houses built on a site. These illustrations are from "Designing Open Space Subdivisions" by Randall Arendt, September, 1994, which is available from the Natural Lands Trust at (610) 353-5587.

treating land use as a major component of this Comprehensive Conservation and Management Plan.

B. Barriers and Obstacles to Achieving the Delaware Estuary Program's Land Use Goals and Objectives

Land use issues are inherently a challenge to address because they relate to basic questions of individual property rights and the effect of government action on those rights. In addition, many property owners, such as farmers, rely on equity in their land and their ability to realize that equity for retirement income. Barriers and obstacles to achieving the Program's land use goals and objectives, which are discussed throughout this chapter, include:



An estuary watershed that lies in three states, each with its own land use statute. The Delaware Estuary Program does not suggest that land use statutes for all three states should be the same. Instead, our focus is on encouraging similar planning processes in the three states, including state or regional-level planning and a stronger county role in coordinating with municipalities, as proposed in Actions L10, L11, and L12;



Land use decisionmaking in individual local governments that does not consider regional impacts of development. The Program's response to this situation is to provide incentives for stronger regional planning, as in Actions L7, L8, and L10. We are also seeking to help communities to look beyond their borders to consider the regional implications of the decisions they make, and to think of themselves as a part of the Delaware Estuary watershed, as in L2, L3, and L4;



Questions of equity with regard to encouraging concentrated development in some places and no development in others. The Program recommends that the issue of equity be addressed at the highest levels of government in Actions L1 and L12;



Hesitation on the part of local governments to try innovative approaches to development proposed by developers because of legal and regulatory constraints and a fear of relatively untried



development techniques — which can result in "cookie-cutter" zoning ordinances, which promote traditional sprawl development and are not adapted to an individual municipality's natural resource protection needs. In addition to incentives for innovative planning, the Program proposes to provide local governments with various forms of technical assistance in Actions L12, L13, and L14;



A complex web of laws and regulations, implemented at various levels of government, that can discourage developers from trying new approaches, lead to costly delays in projects and foster resentment toward environmental protection efforts, which are viewed as bureaucracy-driven. The Program proposes changes in specific regulations and practices that seem to hamper approaches to development and growth that lead to sustainable development, detailed in Actions L16, L17, and L18; and



A reliance on property taxes in each of the three Estuary states to support local government services, such as schools, which encourages municipal governments to promote development to generate tax ratables and, in so doing, foster suburban sprawl. Although the Plan does not include a specific recommendation relating to the property tax issue and the pursuit of ratables, this is an issue that the Program will consider in the future.

C. Existing Programs and Jurisdiction Over Land Use

The Delaware Estuary Program, to meet its mandate, must consider the Estuary, which lies in three states, as a *regional* resource requiring a *regional* perspective for protection. Superimposed on the Estuary system, however, is a web of political boundaries. Today, land use is treated in different ways within each of these boundaries. As a result, natural systems, which rarely are contained completely within one political subdivision, are exposed to varying approaches to land use, dictated by a wide range of federal, state, and local laws, regulations, and programs.

The Delaware Estuary Program, to meet its mandate, must consider the Estuary as a *regional* resource requiring a *regional* perspective for protection.

To better understand this jurisdictional web and the institutional framework for land use management in the region, the Delaware Estuary Program conducted two comprehensive inventories:

- ⇒ Delaware Estuary Program Land Use Management Inventory and Assessment. The Greeley-Polhemus Group, Inc.; and
- ⇒ Delaware Estuary Regulatory Programs Inventory and Assessment. Roy F. Weston, Inc., Oct. 1992.

The information contained in these reports has been updated and consolidated into a comprehensive matrix-format available as a companion document to this Plan.

These inventories have made it clear that the processes for regulating land use in the watershed fail to adequately consider ecosystem-wide environmental needs. A primary problem is that we have approached environmental protection resource by resource: specific laws protect wetlands; other laws protect endangered species; and still other laws protect water quality. Even these fragmented laws are not integrated into the planning and zoning ordinances of individual municipalities. The result is that the current processes for land use management and environmental protection not only fail to look at the relationship between natural systems; they also fail to effectively manage on a resource-specific basis. The process is fragmented and encourages additional fragmentation when what is needed is a unified regional view of resource protection and land use.

The land use component of this Plan advocates making the best use of existing land use laws and regulations and, where necessary, changing them to facilitate a regional, tri-state approach to land use and resource protection.

The challenge that remains is to convince local governments, each with disparate interests and needs, that taking a watershed-wide view of land use and resource protection is in their best interests. Five years of work by the Delaware Estuary Program show that this approach is in their collective best interests.

The roles of various layers of government with regard to land use are described, in brief, below.

The challenge that remains is to convince local governments, each with disparate interests and needs, that taking a watershed-wide view of land use and resource protection is in their best interests.



THE LOCAL ROLE

For the most part, control of land use in the Delaware Estuary watershed is the prerogative of each of the region's 250 municipalities, each of which may plan and zone within its own borders. The authority to do this is given to them by the three states, primarily through their land use statutes: the Municipalities Planning Code (Pennsylvania); the Municipal Land Use Law (New Jersey); and the Land Use Planning Act (Delaware).

Despite the fact that they are governed by distinct and unrelated land use statutes, municipalities in the three states share a common tradition: a heavy emphasis on "home rule." Land use is, in short, a carefully guarded local prerogative in all three states.

THE COUNTY ROLE

In Pennsylvania, counties have the power to plan under the Municipalities Planning Code and, in the absence of municipal zoning, to zone. There are, however, no unincorporated areas in Pennsylvania's Delaware Estuary watershed counties. County comprehensive plans, which are required, are advisory only.

In New Jersey, under the County and Regional Planning Enabling Act, county planning boards have the legal authority to review local applications to ensure that they are consistent with the county's storm water control and transportation plans, and their approval is required for certain development and subdivision applications. As in Pennsylvania, county master plans are not binding on municipalities.

In Delaware, county governments play a similarly advisory role in incorporated areas, but have substantial authority in unincorporated areas, where they have the power to plan and zone. Large portions of Kent, New Castle, and Sussex Counties are unincorporated, and development there is guided by the Quality of Life Act, which provides the direction for county land use and development.

REGIONAL PLANNING

There are no regional planning entities involved in local planning and zoning. The Delaware River Basin Commission, however, has direct control over the extraction and use of water from the Delaware, its tributaries, and the region's aquifers. The Commission also sets water quality standards and is implementing

a nonpoint source control program in the special protection water areas of the Upper Delaware River Basin. As such, the Commission has the potential to play a significant role in the land use decision-making process. To date, it has not played such a role, although there are land use implications inherent in many of the water use and quality regulatory functions it performs.

The Delaware Valley Regional Planning Commission (DVRPC) focuses on the nine-county Philadelphia region in Pennsylvania and New Jersey. A bi-state public agency created in 1965, DVRPC develops regulatory policy and provides technical support and coordination to public and private leaders. As a federally-designated Metropolitan Planning Organization, DVRPC addresses a range of development issues related to transportation, land use, and the environment. The Intermodal Surface Transportation Efficiency Act (ISTEA) transformed DVRPC from an advisory body into a stronger implementing agency by giving it a greater role in the distribution of federal and state funding to transportation projects in the Delaware Valley region. ISTEA also requires DVRPC's transportation planning efforts to integrate land use, environmental protection, and transit services.

THE STATE ROLE

The three state governments are involved in day-to-day land use issues primarily through their regulatory functions (controlling floodplain development and disturbance of wetlands, for example) and through related activities of state agencies, particularly transportation and environmental protection departments. But the states, in all three cases, grant the authority to regulate land use through planning and zoning to municipalities (and, in some cases, counties) and therefore have the legal power to change the laws governing land use.

In recent years, the most dramatic exercise of this authority in this region was the passage of the State Planning Act in New Jersey in 1985. Under this Act, a state plan, setting policies and goals for land use patterns throughout the state, has been adopted and is now being implemented. A primary means of implementing the State Plan is requiring state agencies to follow it as, for example, they determine where to invest state funds in capital projects. Local governments are not compelled to follow the plan, but they will be rewarded for doing so.



THE FEDERAL ROLE

As with the states, the federal role in land use primarily is regulatory or related to acquisition of land for public uses. The federal government also funds capital projects that have major effects on land use, however, and that have done much to shape present land use patterns. Examples include the funding of the interstate highway system and public sewage systems, which have promoted sprawl, and requirements of ISTEA, related to the Clean Air Act of 1990, which are likely to encourage more compact, transit-oriented growth.

D. Sustainable Development Through Watershed-Based Land Use Planning

It is clear that the Delaware Estuary watershed is a unified ecosystem, and that the health of one part of the system has a direct effect on the health of the other parts. We know that what we do with the land in the watershed, for example, has a major impact on its water and wildlife.

It is also clear that, although individual land use decisions made in municipalities throughout the watershed have incremental, cumulative effects on the entire ecosystem, regulations and laws in the three watershed states fail to comprehensively consider the regional effects of local actions.

Therefore, to promote a regional perspective on protection of the Estuary, the Delaware Estuary Program advocates a new approach to land use regulation: sustainable development achieved in the near-term through watershed-based planning and, in the long term, through the development and implementation of a Comprehensive Environmental Policy Plan for the Delaware Estuary region. All of the actions recommended at the end of this chapter have been designed to build a foundation for these approaches to sustainable development in the Delaware Estuary watershed.

SUSTAINABLE DEVELOPMENT

The concept of *sustainable development* offers exciting possibilities for a new vision of land use and environmental protection in the Delaware Estuary watershed.

The Delaware Estuary Program advocates a new approach to land use regulation: sustainable development achieved in the near-term through watershed-based planning and, in the long term, through the development and implementation of a Comprehensive Environmental Policy Plan for the Delaware Estuary region.

As defined in Chapter I, sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition provides a broad framework under which other, more specific, definitions and examples may be put into context.

One of these was articulated in an address delivered to a forum on sustainable development convened by the Delaware Estuary Program in late 1993. Steven Viederman, executive director of the Jesse Smith Noyes Foundation in New York, expanded the Brundtland definition and defined sustainability as:

A community's control and prudent use of capital—all forms of capital; natural capital and cultural capital—to ensure...that present and future generations can attain a high degree of economic security and achieve democracy while maintaining the integrity of the ecological systems upon which all life and all production depends.

We are, however, a long way from achieving sustainability as defined by the Brundtland Report or Steven Viederman. Municipal officials often want to do the right thing for the environment, but they are forced to seek development to pay for roads, schools, parks, drinking water, sewage treatment, and solid waste disposal. While growth and development increase tax revenues, they also create problems, particularly when they follow sprawl patterns. These problems include higher costs for services, increased amounts of sewage and solid waste, more polluted runoff, energy-inefficient and dependent communities, degraded water, and increased risks of flooding.

Sprawl development is not sustainable; one primary manifestation of this fact is that it continually pushes development away from itself as it destroys environmental systems and undermines communities it absorbs and leaves behind. The challenge for local officials is how to allow for needed growth without destroying the qualities that make their communities desirable places to live and work. The answer, which is magnified in effectiveness as it moves from the local to the regional, watershed level, lies in the principles of sustainable development.

We have learned that effective, long-term environmental protection cannot be achieved through conventional pollution control measures alone, although these are essential. The threat of nonpoint source pollution to the Estuary's water quality, for example, is evidence of this important fact. We have also learned

The challenge for local officials is how to allow for needed growth without destroying the qualities that make their communities desirable places to live and work.



that the way we use our land has a direct impact on the environment, and on the quality of life in our cities, towns, and villages. Deteriorating urban cores, disjointed suburban sprawl, polluted air, traffic congestion, and loss of aesthetic quality in the urban and suburban parts of the watershed are daily reminders of this.

We need both a clean and healthy environment and vibrant, stable communities. The trends that have emerged under the traditional way of operating over the past several decades indicate that this is not the direction in which we are moving, however. What is needed is a dramatic new approach to environmental protection, including a mix of new, clean technologies so that industry is more efficient and does not undermine environmental quality and, therefore, quality of life. To have a sustainable society, we must make structural changes in our modes and methods of production as well as in our patterns of consumption—of goods, of water, of land.

Creation of truly sustainable communities in the Delaware Estuary watershed will require a comprehensive approach to planning and community design, the application of non-traditional growth management principles, and an effort to shift market forces to protect the Estuary.

WATERSHED-BASED LAND PLANNING

Watershed-based land planning is an important tool for controlling nonpoint source pollution and storm water runoff and for managing growth from a regional perspective in a way that protects natural resources and promotes compact, traditional communities.

Successful watershed-based land planning must take a variety of elements into account. These include the hydrologic cycle, the location and extent of natural resources, carrying capacity and growth limits, intermixed conservation and developed areas, preservation of critical natural areas, and recentralization.

There are many existing projects and programs, offered by a panoply of federal, state, county, and local government agencies and the not-for-profit sector, that can be important components of

To have a sustainable society, we must make structural changes in our modes and methods of production as well as in our patterns of consumption —of goods, of water, of land.

a regional watershed-based land planning effort. Examples include:

- ⇒ The projects of the Brandywine Conservancy, the Natural Lands Trust, the New Jersey Conservation Foundation, the Nature Conservancy, and other land trusts and watershed associations, which focus on environmental protection through private landowner participation in land management programs, technical assistance to municipalities on innovative approaches to planning and land use, and acquisition of land and conservation easements;
- ⇒ The GreenSpace Alliance, which has brought together a variety of county and local governments and not-for-profit organizations with the goal of protecting open space and promoting environmentally-sound planning in Southeastern Pennsylvania;
- ⇒ The Burlington County Transfer of Development Rights program and the Chester County and Montgomery County open space bond programs;
- ⇒ The State of Delaware's Coastal Heritage Greenway, the State of New Jersey's Green Acres Program, and the State of Pennsylvania's Keystone Recreation Park and Conservation Fund, all of which protect open space for recreation, conservation, and natural resource protection; and
- ⇒ The federal Wild and Scenic River program, which has been used on the Maurice River, where it spawned coordinated land use plans in four river townships in Cumberland County.

Standing alone, each of these efforts is significant. If, however, the three Estuary states adopted policies that promote coordinated watershed-based planning throughout the region, their effectiveness would be enhanced dramatically. One way to achieve this end is through the implementation of a Comprehensive Environmental Policy Plan for the entire Estuary watershed.

COMPREHENSIVE ENVIRONMENTAL POLICY PLAN FOR THE DELAWARE ESTUARY

The tradition of local planning and zoning is deeply embedded in the Delaware Estuary region, guided by land use statutes in each of the three Estuary states. These facts seem to represent an



insurmountable barrier to an Estuary-wide approach to land use and environmental protection, but, in fact, they are not.

Local governments and the states, as well as business and industry, and citizens in all of these jurisdictions, however, all have an interest in protecting their environment. Forging a comprehensive policy plan for the Delaware Estuary would not be a matter of undermining long-standing traditions of home rule, but rather one of capitalizing on the interest we all have in the most effective and efficient approach to environmental protection.






A regional policy plan would be developed through a consensus-building process involving many Estuary region interests and based on solid science. It would set out guidelines for environmental protection, land use, sustainable development, and use of resources for the region which, in turn, would be implemented through the individual state land use laws, environmental statutes and regulations, and county and local zoning ordinances and policies. It would enable local officials—who have demonstrated a commitment to careful use of resources and effective environmental protection policies—to consider the regional impact of the decisions they make.

The regional policy plan would be a manifestation of two basic changes wrought by the Delaware Estuary Program: a new land ethic that reflects our awareness that we are "individual members of a community of interdependent parts," and a commitment to civic environmentalism, which reflects the role individuals can play in environmental protection through their daily behavior. The result would be tremendous advances toward the ultimate goal of achieving sustainability.

Local governments and the states, as well as business and industry, and citizens all have an interest in protecting their environment.

Recommendations

Actions pertaining to Land Management have been grouped into five categories as follows:

-  *Sustainable Development* — to promote and facilitate development that provides housing, jobs, and revenue without destroying the Estuary watershed's natural resources.
-  *Watershed-based Land Planning for Nonpoint Source Pollution Control* — to support the efforts of the states in achieving Coastal Zone Act and Clean Water Act program objectives to reduce the flow of nonpoint source pollutants, both toxics and nutrients, into the tributaries and mainstem of the Delaware Estuary.
-  *Increased Regional Coordination, Planning, and Decision-Making* — to provide incentives for regional coordination in planning and infrastructure decision-making.
-  *Technical Assistance and Funding* — to provide local governments with the information, data, and means to use tools to achieve environmentally-sound planning.
-  *Legislative and Regulatory Changes* — to promote preservation of natural resources, reduce pollutant emissions, and streamline government processes.



SUSTAINABLE DEVELOPMENT

ACTION L1: Develop a Comprehensive Environmental Policy Plan for the Delaware Estuary

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L1: Comprehensive Environmental Policy Plan for the Delaware Estuary	<i>Lead:</i> Delaware Estuary Foundation/partnerships	Short-term	\$50,000

Why: A major objective of the Delaware Estuary Program is to achieve a sustainable economy within the watershed of the Delaware River and Bay within one generation, or by the year 2020. Current trends of land consumption, water depletion, pollution loading, and depletion of renewable and non-renewable resources will eventually exceed the carrying capacity of the environment.

What and How: A non-traditional environmental policy plan which focuses on controlling environmental problems at their source and establishing clear targets and timeframes for environmental results is needed.

To initiate this process, the Delaware Estuary Program proposes that the Governors of Pennsylvania, Delaware, and New Jersey convene a Delaware Estuary Watershed Sustainable Development Summit. The Delaware Estuary Foundation would seek to develop partnerships with groups like the Stockton Alliance and other organizations with demonstrated leadership in this area.

ENVIRONMENTAL POLICY PLAN

-  A commitment to long-term reshaping of social and economic structures
-  The integration of environment concerns into decision making by all sectors of society
-  The adoption of quantified (measurable) targets and timeframes
-  Clear identification of responsibility for actions
-  Creativity in the design and use of policy instruments
-  Encouraging pollution prevention practices

These organizations would collaborate to organize the goals, objectives, participants, and logistics of the Summit.

The purpose of the summit would be to:

- 1) **Establish a framework for development of an Environmental Policy Plan by October 1996.**
- 2) **Create a Blue Ribbon Panel to steer plan development and set environmental quality objectives and pollution reduction targets.**
- 3) **Formalize a policy for a target group, sectoral approach in which environmental problems can be addressed by different parties at the appropriate time. Examples of target groups and sectoral issues are: Agriculture, Economics, Ecosystem Management, Fisheries, Forests, Wetlands, Energy Production and Use, Manufacturing, Natural Resources, Mining, Oil and Natural Gas, Public Resources, Education, Health, Population, Real-estate, Recreation and Tourism, Transportation, and Urban and Suburban Development.**

Implicit in this process is a recognition that government alone, or a command and control approach, cannot achieve lasting environmental improvement. Accordingly, the plan will lay the foundation for an incentive structure which encourages and requires, where necessary, all sectors of society to make decisions that will minimize adverse environmental impacts while maximizing sustainable economic development. Regional leaders from both the private and public sectors would be the target participants.

It is very important that deliberations concerning environmental quality objectives and setting measurable targets be based on good science, new technologies, and the best information available. The data compiled and studies commissioned by the Program should greatly facilitate this process.

Measure of Success: Consensus on broad environmental quality objectives by October 1996. Initiation of processes to reach pollution reduction and sustain-able resource consumption targets within specific timeframes.



WATERSHED-BASED LAND PLANNING FOR NONPOINT SOURCE POLLUTION CONTROL

This Action Plan is designed to support the efforts of the states in achieving their Coastal Zone Act and Clean Water Act program objectives. It proposes to provide regional satellite and GIS information to the states to assist them in tributary watershed ranking, in the identification of critical areas within watersheds, and with watershed-based land planning and storm water management planning. The Action Plan also provides for an information clearinghouse for municipalities and landowners to learn how they could work cooperatively with county conservation districts, agricultural assistance programs, the riverkeeper network, conservancies, and other groups.

The purpose of these actions is to reduce the flow of nonpoint source pollution (NPS), both toxics and nutrients, into the tributaries and the mainstem of the Delaware Estuary. As point sources (factories and wastewater treatment plants) of these pollutants have been better controlled, the importance of controlling nonpoint sources has increased.

ACTION L2: Support Watershed-Based Planning

Why: The states all have programs that focus on protecting water quality, including impacts from nonpoint sources and stormwater. These programs need support in obtaining and using technical tools and data, using the data and tools for watershed-based planning, and educating agencies and the public on watershed-based planning.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L2: Watershed-Based Planning			
L2.1: Identification of Land Use/Land Cover Patterns	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> USEPA, PADER, NJDEP, DNREC	Long-term	\$16,500 per year plus USEPA, USDA-ASCS, USGS in-kind services
L2.2: Identification of Critical Areas	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> USEPA, USDA-ASCS, PADER, NJDEP, DNREC	Mid-term	\$16,500 per year plus USEPA, USDA, USGS in-kind services
L2.3: Tributary Watershed Ranking	<i>Lead:</i> PADER, NJDEP, DNREC <i>Partners:</i> Delaware Estuary Foundation, USEPA	Mid-term	\$300,000
L2.4: Reports on Demonstration Projects	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> PADER, NJDEP, DNREC, USEPA	Long-term	\$16,500 per year plus state in-kind services for documentation

The Delaware Estuary Foundation should support the states' coastal zone, storm water management, and nonpoint source reduction programs by brokering the acquisition of Landsat Thematic Mapper and air photo data, the use of Geographic Information Systems, and the provision of professional expertise for the identification of regional land use/land cover patterns and critical nonpoint pollutant loading areas, for ranking tributary watersheds, and for the preparation and distribution of reports on demonstration basin projects.



The Delaware Estuary Foundation should work with public and private sector environmental groups to establish a communications network, through the Regional Information Management Service, the Internet USEPA Nonpoint Source Bulletin Board, or through some other medium, to promote the exchange of information on data, technologies, technical service providers, and funding opportunities. The Delaware Estuary Foundation could add value to the tri-state storm water management and nonpoint source pollution control process by facilitating the dissemination of information.

Measure of Success: Identification of land use/land cover patterns in tributary watersheds (1998-2000). Identification of critical areas on the basis of high current or potential nonpoint source pollutant loadings to surface and groundwater bodies (1996). Ranked tributary watersheds based on estimated pollutant loadings, development patterns, and other factors (1997). Demonstration watershed projects conducted (2000-2005).

Action L2.1: Support the Identification of Land Use/Land Cover Patterns in the Tributary Watersheds

What and How: This action calls for the Estuary Foundation to support an ongoing process of identifying land uses which individually or cumulatively might cause or contribute significantly to the degradation of: 1) coastal waters which fail to attain or maintain applicable quality standards or to protect designated uses; or 2) coastal waters that are threatened by foreseeable increases in pollutant loadings from new or expanding sources.

Landsat Thematic Mapper imagery, (classified by USEPA-Office of Research and Development), Orthophoto Quads (prepared by USGS), and other aerial photography, such as the low level crop verification imagery used by USDA-ASCS, could be acquired by the Delaware Estuary Foundation on behalf of the states for identifying and delineating land cover/land use patterns on which to assess potential pollution loadings to surface and groundwater bodies in the tributary watersheds.

Action L2.2: Support the Identification of Critical Areas

What and How: The Coastal Zone Act calls for a two-tiered management approach for the control of nonpoint sources of pollution: 1) the implementation of management measures to protect coastal water generally, and 2) the implementation of additional measures as a second tier of control for critical coastal areas needing added protection against predictable pollution impacts.

To assist the states in locating nonpoint source pollution-related threats to surface and groundwater quality in the Estuary's tributary watersheds, the Delaware Estuary Foundation would broker the acquisition of Landsat Thematic Mapper and aerial photographic imagery; cartographic, water quality, and other data types; and the use

of GIS systems and nonpoint source pollution loading models to identify and map critical coastal areas.

The states would identify impaired and threatened areas in the Estuary, delineate corresponding land uses and critical coastal areas, and confirm where additional management measures must be implemented. There are two approaches for delineating critical coastal areas. The first approach involves establishing a strip along the shoreline adjacent to the threatened or endangered waters, extending the boundaries inland, and imposing special land use controls within the area. The second is the ecosystem, or watershed, approach, which involves starting with a segment of the shoreline and extending its boundaries inland to encompass an entire watershed or other ecologically significant feature of the landscape.

After identifying the land uses and critical coastal areas, the states would implement management measures and monitor them with reference to performance standards. Where initial measures fail to meet performance standards, additional management measures would be selected from among a broad range of structural and non-structural nonpoint source controls to add other layers of protection.

State coastal nonpoint source pollution control programs would provide assistance to local governments and to the public for implementing the additional management measures. Such assistance might include developing ordinances and regulations, a technical guidance manual, models to predict and assess the effectiveness of measures, field training, financial incentives, demonstration projects, and other innovations to protect coastal water quality and designated uses.

Local resident citizens should be involved as early as possible in the development and implementation of the coastal nonpoint source pollution control program. Public education should target audiences who are affected or regulated and those who can and will assist in planning and implementing the program.

The states' first tier nonpoint source programs are not expected to come on-line until 1998 at the earliest. Therefore, the Delaware Estuary Foundation should address the second tier objectives proactively by arranging for the acquisition of Landsat Thematic Mapper Scenes, Orthophoto Quads, aerial photography, and other data with which to identify land uses that degrade or threaten to degrade water quality in coastal areas. The identification of critical coastal areas should be accompanied by environmental education programs to stimulate better public understanding and cooperation.

Remote sensing technology could be used to track regional development trends and to predict where the more severe water quality degradation impacts will occur. This capability will become an important tool for enabling environmental managers to allocate limited financial and technical resources to critical areas in priority watersheds for prevention and mitigation efforts throughout the Estuary region.



Action L2.3: Rank Tributary Watersheds for Storm Water Management Planning and Nonpoint Source Pollution Control

What and How: States would rank tributary watersheds by comparing current land use patterns, development projections, water quality monitoring data, local residents' willingness to participate in water pollution remediation and prevention activities, nonpoint source pollutant loading estimates, and other factors.

By ranking the watersheds, state environmental agencies could allocate resources to water pollution prevention and remediation efforts based on the severity of actual or potential nonpoint source degradation impacts to surface and groundwater bodies.

Action L2.4: Prepare and Disseminate Reports on Demonstration Basin Projects

What and How: The states would designate demonstration projects in different basins in the Estuary region. Storm water management and utility planning are being done in the Dover-Silver Lake watershed; the Maurice River watershed was designated as "Wild and Scenic"; and TMDLs and water-based zoning are important program elements in the Brandywine watershed. These projects demonstrate how particular storm water and nonpoint source pollution control problems can be addressed.

The Estuary Foundation would prepare and disseminate reports about these basin projects to public and private sector environmental groups in the Delaware Estuary and mid-Atlantic region.

ACTION L3: Support the Implementation of Coastal Zone Act Management Measures

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L3: Implementation of CZARA Management Measures	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> USEPA, PADER, DNREC, NJDEP, Conservation Districts, USDA, USFS, USFWS	Long-term	\$50,000 per year

Why: All three states are now developing their programs to control coastal nonpoint source pollution as required by the Coastal Zone Management Act. They need information on the technologies, sources of expertise, and funding sources to implement their programs.

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What and How: The Delaware Estuary Foundation would support the states' efforts to implement management measures and BMPs in watershed-based land planning programs emphasizing the critical areas mentioned in L2.2 above. The management measures fall in the categories of agriculture, marinas and recreational boating, riparian buffers, wetlands, hydromodification, and urban.

"Management Measures" are defined as: "... economically achievable measures to control the addition of pollutants to coastal waters, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint source pollution control practices, technologies, processes, siting criteria, operating methods, and other criteria." "Measures" are pollution control systems made up of site and situation-specific "Management Practices" which function together to achieve the goals of the "Management Measures" (CZARA Section 6217 Guidance).

County Conservation Districts, USDA-SCS, federal and state Forest Services, state environmental agencies, municipalities, and other implementing entities would install management measures and practices at tributary watershed sites based on nonpoint source pollution impacts to surface and groundwater bodies and other area-specific factors.

The Delaware Estuary Foundation would serve as a clearing house for information on technologies, practices, civil engineers, planners, landscape architects, storm water specialists, funding sources, data, and other information for the implementing entities.

Measure of Success: In critical coastal areas in the tributary watersheds where high nonpoint source impacts to surface and/or groundwater bodies have been recorded, the extensions of the riparian landscape are delineated in GIS to identify sites where "treatment trains" of management measures and BMPs will be installed.

Demonstrable improvements in ground and surface water quality after management measures and BMPs are installed in critical coastal areas. In suburban and rural areas, the landscape elements associated with the water regimen are protected, in intermunicipal watershed-wide comprehensive master plans and zoning ordinances, from being over-developed.



ACTION L4: Support the Establishment of Riparian Corridor Protection Programs

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L4: Riparian Corridor Protection Programs	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> DNREC, PADER, NJDEP, USFWS, NPS, USDA, Conservation Districts, Watershed associations	Long-term	\$50,000 per year plus USFS, USEPA, USDA, USGS in-kind services

Why: In rural, developing, and urbanized watersheds, riparian corridors should be protected from storm water impacts by forested or vegetated buffers and by reconstructed stream banks designed in accordance with surrounding land uses, vegetation patterns, topography, severity of pollution impacts on water quality, and related factors.

What and How: A stream protection program could be developed by negotiating with and building consensus among engineering, homebuilding, environmental, and other groups. The degree to which buffers are established along particular reaches would depend on the extent to which they are or would be degraded by pollution impacts. Stream protection should be integrated into the overall strategies for water quality management in the Estuary region. The revegetation of riparian corridors should be based on their soil; hydrologic, geologic, and topographic factors; land use; and other factors.

Buffers can protect streams, their associated wetlands, floodplains, and erodible slopes by filtering nutrients and toxics; by reducing erosion and sedimentation; by stabilizing streambanks; by infiltrating storm water; by maintaining stream baseflow; by providing organic matter for the aquatic food chain; by lowering stream temperatures; by providing wildlife habitat; by providing scenic value and recreational opportunity; and by minimizing water resources expenditures.

Whenever possible, riparian corridor restoration planning should be done in association with wildlife habitat protection and restoration planning to maximize opportunities for linking fragmented interior habitats.

The overall amount of natural land needed by various species might exist in fragmented landscapes, but in divided, isolated patches. Greenways can join smaller diverse habitat types, and animals can move among them to utilize their total area, not just that of individual patches.

Many species use riparian corridors to move through the landscape. Thus, establishing greenways in riparian zones is an effective way to protect stream networks' wildlife support functions. In addition to these wildlife issues, the greenway design process involves such water resources protection and conservation concerns as flow moderation, nutrient and sediment filtration, temperature regulation, bank stabilization, and food and habitat for aquatic communities.

The Delaware Estuary Foundation would assist municipalities, conservation districts, watershed associations, trusts, conservancies, and other groups involved in riparian corridor restoration and protection projects by brokering the acquisition of data and arranging for its analysis, by distributing technical information, by linking technology and professional consultants to projects, and by locating funding sources.

Measure of Success: In prioritized watersheds throughout the Estuary region, streams which are susceptible to nonpoint source pollution impacts are mapped. Cost estimates for riparian buffer protection projects are prepared. Projects are implemented according to completion schedules organized in terms of protection strategies per distance of riparian corridor per time per measurable water quality improvement. (The ability of a riparian zone to perform its function will depend heavily on the status of upstream vegetation, uses of associated uplands, and the successional stages of the riparian zone vegetation.



ACTION L5: *Support the Implementation of Urban Best Management Practices*

Why: Runoff from urban areas of the Delaware watershed is a significant source of water pollution. While retrofits of existing storm water management practices and restoration of streams and wetlands are not simple tasks, they can provide great benefits.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L5: Implementation of Urban Best Management Practices			
L5.1: Urban BMP Retrofits	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Watershed associations, USEPA, PADER, NJDEP, DNREC, Conservation Districts	Long-term	\$12,500 per year
L5.2: New Urban BMP Retrofits	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> USEPA, PADER, NJDEP, DNREC, Conservation Districts, watershed associations	Long-term	\$12,500 per year
L5.3: Urban Wetlands Creation and Restoration	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> PADER, NJDEP, DNREC, Conservation Districts, watershed associations, USEPA	Long-term	\$12,500 per year
L5.4: Community Stream Restoration Programs	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> PADER, NJDEP, DNREC, Conservation Districts, watershed associations, USEPA	Long-term	\$12,500 per year

This action calls for retrofits to older BMPs, the adaptation of new BMPs to the built landscape, the creation and restoration of urban wetlands, and the restoration of community streams.

Urban BMPs are designed to approximate pre-development hydrologic regimes by infiltrating, retaining, or detaining the greater flows of storm water produced by urban development. Urban BMPs are a simple solution to a complex problem. Although urban BMPs may partially reduce the increased loads of pollutants generated in developed areas, they cannot fully mitigate the wide range of impacts that occur with urbanization. They can never compensate for poor watershed master planning, inadequate stream buffer networks, or improper site planning.

As a node on national and regional networks, the Delaware Estuary Foundation would assist implementing entities by providing information concerning available technical support services from private sector consultants or public sector agencies; management measure and BMP installation; private and public sector funding sources, and other information.

Measure of Success: Where urban streams and other surface water bodies are subject to storm water pollution and other nonpoint source impacts, urban BMPs are installed. The newly installed BMPs are mapped and included in municipal storm water master plans and comprehensive plans. Stream water quality improvement is reflected in monitoring results.

Action L5.1: Support Urban BMP Retrofits

What and How: The Delaware Estuary Foundation would act as a technical information and funding broker to support projects that retrofit older urban BMPs with alternative storm water uses.

Older BMPs offer opportunities for retrofitting at modest cost. Older dry storm water ponds, for example, can be converted into wet pond marsh systems.

Action L5.2: Support Retrofits to New Urban BMPs before Community Stream Protection Strategies are Implemented

What and How: The Delaware Estuary Foundation would broker the acquisition of funds, information, and appropriate technologies to support public agencies' efforts to implement urban BMP retrofit programs, particularly if it can be demonstrated that the proposed urban BMPs will improve the amenity value on those public lands. Peat sand filters, oil-grit separator inlets, and extended lake/wetland systems are among the BMPs which could be installed in already developed watersheds.

Action L5.3: Support the Creation and Restoration of Urban Wetlands

What and How: Despite regulatory protection, most watersheds have lost and will continue to lose large areas of freshwater and tidal wetlands to the development process. Since urban storm water runoff degrades wetlands in the same ways that it degrades urban stream ecosystems, it is critical to restore and manage urban wetlands rather than merely conserve them. It is equally critical to create new urban storm water wetland areas to partially substitute for the lost ecological functions of the destroyed or degraded wetland ecosystem.

Action L5.4: Support the Organization of Community Stream Restoration Programs

What and How: Community residents adopt streams and conduct stream watches; plant trees; and report oil spills, sewer overflows, and other pollution problems. For stream restoration programs to be successful, communities must be willing to give



them the same priority as economic growth and the creation of urban infrastructure. If these conditions are met, it is possible to mitigate the effects of development and maintain quality stream systems for future generations. The Delaware Estuary Foundation would broker the acquisition of information and funding for these programs.

INCREASED REGIONAL COORDINATION, PLANNING, AND DECISION-MAKING

Analysis of the existing land use management framework identifies two key problems:

- 1) Little effective regional planning occurs relative to issues of open space and water quality; and
- 2) Land use decision-making takes place primarily at the municipal level and focuses on municipal concerns; environmental protection and regional resource management are generally a low priority.

The Delaware Estuary Program proposes to work with local governments to help them guide growth more wisely, while maintaining economic health. Local governments can use their powerful planning and zoning authority to encourage land uses that will maintain and improve the environment, while stimulating growth where appropriate. The Delaware Estuary Program can help local governments by providing coordination, a regional perspective, and incentives to take a more regional approach to planning.

ACTION L6: Identify and Support Greenspace Program Plans to Protect Natural Resource Areas Related to the Estuary

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L6: Greenspace Program Plans	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> State and county planning organizations and conservation organizations, including metropolitan planning organizations, and DRBC	Short-term	\$50,000 a year for 2 years

Why: Greenspace planning programs are not well coordinated regionally. If the Program helps to coordinate and promote greenspace programs, Program goals can be integrated into the greenspace plans and the overall effectiveness of both programs can be enhanced.

What and How: All greenspace programs, both active and proposed, would be inventoried. This information would then be mapped for the watershed and analyzed

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to compare it with watershed priorities for habitat protection and water quality of the Delaware Estuary. Several existing programs, such as the Greenspace Alliance and the Delaware River Greenway, are already providing a coordinating function. The Delaware Estuary Foundation would work with these organizations to support their work and to integrate Delaware Estuary Program priorities with theirs. Where gaps in greenspace plans are identified, the Delaware Estuary Foundation would provide technical assistance to protect greenspace, including identification of funding sources. This effort should include both acquisition of land for public use and acquisition of easements and other conservation techniques that leave land in private ownership. Other forms of technical assistance would include information on the management of open space and the effects of open space on property values.

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 provides opportunities for incorporating greenspace for bikeways and pedestrian paths into transportation plans.

Measure of Success: By 1997, map of existing and proposed greenspace programs and established mechanisms for coordination and technical assistance. Thereafter, protection of three critical tracts per year.

ACTION L7: Support Environmental Agreements among Municipalities and Counties

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L7: Environmental Agreements among Municipalities/ Counties	<i>Leads:</i> PADCA, DNREC, NJDEP <i>Partners:</i> Circuit rider, counties, municipalities	Short-term	\$75,000 per year

Why: Municipalities do not generally consider the impacts of their decisions on other municipalities, nor do they typically share information.

What and How: Municipalities should voluntarily work together to protect their shared resources and improve the environment. One way of formalizing this commitment would be to establish an agreement on 1) how to share information and ideas, and 2) actions to revise and update municipal regulations to support common goals. Municipalities and counties could use these agreements to implement a watershed planning approach across their boundaries.



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In carrying out this action, the Delaware Estuary Council would support multi-municipal agreements through:

- 1) evaluating existing state ordinances that allow such agreements,
- 2) supporting modifications if needed, and
- 3) providing technical support through a circuit rider for developing the compacts.

Pennsylvania already provides for such agreements; however they are not used often.

Measure of Success: Three agreements in the first year, increasing to 30 agreements in five years.

ACTION L8: Establish Minimum Standards for County Plans and Require Inter-County Coordination

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L8: Minimum Standards for County Plans and Inter-County Coordination			
L8.1: Legislation for Minimum Standards and Coordination	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> State agencies and legislatures	Short-term	\$25,000 for one year
L8.2: Implementation of Standards	<i>Lead:</i> Counties, with state oversight	Mid-term	\$25,000 per year

Why: All counties in the watershed have comprehensive or master plans that address some environmental issues, but most of the plans do not address all concerns. They also fail to address watershed issues. This means that municipalities do not have adequate guidance on the regional impacts of their actions.

What and How: This action has two goals: 1) establishment of state standards for the environmental elements of county master or comprehensive plans, and 2) state-mandated inter-county coordination to assess the watershed impacts of major projects. This action proposes that each county prepare county plans for water supply, sewage facilities, wetlands protection, storm water quantity and quality,

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redevelopment, and open space, according to standards defined by the states. Counties would need financial support for this effort.

This action also proposes that counties be required to assess the watershed impact of major facilities. Multi-municipal agreements could be a tool for implementation of this action. It would help to achieve compliance with many of the urban management measures of coastal nonpoint source pollution control plans under development by each state.

New legislation would be required in all three states. Delaware would need to include legislation to allow counties to plan for incorporated areas as well as unincorporated areas.

Measure of Success: Within three years of legislation, three counties in full compliance. Each year thereafter, three additional counties achieve full compliance until all are completed. At least six examples per year of inter-county coordination in watershed assessment.

ACTION L9: Provide Incentives for Increased Municipal Compliance with County Plans

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L9: Incentives for Increased Municipal Compliance with County Plans	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Circuit rider; state and federal planning, transportation, economic development, natural resource agencies; counties; municipalities	Short-term	\$25,000

Why: Land use planning takes place at the local level. Municipalities have little incentive to consider the regional impacts of their planning decisions.

What and How: This action would create additional incentives for municipalities to comply with county comprehensive plans. One way to accomplish this objective is through an expanded role for municipal government input into state actions such as ISTEAP planning, economic development, and state land management. This expanded role should be provided only if the planning complies with county or regional plans for natural resource protection as described in Action L8. For example, Federal Economic Development Agency grants would be preferentially granted to communities whose planning and zoning conform to county natural resource plans. Another example is the ISTEAP requirements for metropolitan planning, in which maintenance and



expansion of transportation infrastructure should be dependent on land use planning to reduce highway congestion.

Development of these incentives would require analysis of where local input would be appropriate for planning purposes, and where municipalities would like to be able to affect the state planning and funding process. State and federal programs would work together to review opportunities for increased municipal influence, and develop specific recommendations. Implementation mechanisms would be development of internal policies, promulgation of regulations, and possibly an executive order at the state level.

For increased effectiveness in coordination, the Delaware Estuary Program recommends that a protocol be established to ensure municipal compliance with county environmental plans. This means that municipal comprehensive plans, zoning, and subdivision review procedures would be revised to conform to the county plans. This would require modification of the state enabling legislation. State funding and permits should be dependent on conformance with county plans.

Measure of Success: State and federal agency agreements established by October 1996. By October 1997, 10 municipalities with revised comprehensive plans and zoning, increasing by 20 municipalities each year.

ACTION L10: *Expand State and/or Regional Planning and Technical Guidance to Local Governments*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L10: State and/or Regional Planning and Technical Guidance to Local Governments			
L10.1: Delaware	<i>Lead:</i> Legislator/Governor action in PA and DE. New or expanded existing state planning or policy agencies for implementation	Short-term	\$100,000 per year
L10.2: Pennsylvania			

Why: Land use decisions at the local level often fail to consider the regional impacts of development. Also, local governments need information and technical assistance that can only be provided from a state or regional level.

Action L10.1: Establish a State Planning Organization (Delaware)

Action L10.2: Strengthen State Level Planning or Support Establishment of a Strong Regional Planning Organization (Pennsylvania)

What and How: State and regional planning organizations help to introduce new techniques such as water quality-based land use planning to local governments. The objective of this proposed action is to improve local use of the comprehensive planning, zoning, and subdivision process to meet local and regional needs for open space and clean streams. The states should provide technical guidance on issues such as population and growth targets and find ways to implement state land use policies through existing state programs.

Expanded state or regional planning can offer two further benefits. One is the support of local planning by identifying environmental constraints that limit local growth. This can provide the nexus between the environment and planning decisions that has been required in recent court decisions on land use.

The second role of state planning is development of policies on how to ensure that the burdens and benefits of development and of protecting the environment are shared fairly among all citizens.

The New Jersey State Development and Redevelopment Plan, while not perfect, offers an excellent framework for long range planning, provides targets for counties and local



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government planning, and provides incentives for participation. The foundation of the plan is equity for all citizens. The Delaware Estuary Program supports full implementation of the New Jersey State Plan.

While New Jersey has a structure for state level planning, Delaware needs to establish a structure for state level planning to provide targets, develop policies, and promote regional coordination for local governments. Pennsylvania has recently established a state level "Futures Council" which will focus on economic development. Pennsylvania needs to provide for state level environmental planning or, alternatively, regional planning focused on the Delaware Estuary.

Measure of Success: Active state or regional planning organizations focusing on environmental issues in all three states by October 1997.

TECHNICAL ASSISTANCE AND FUNDING

In order to effectuate change through the implementation of the CCMP actions, the Delaware Estuary Program will need to identify ways in which it can provide technical assistance and funding to local governments and other local initiatives. This assistance and funding should be linked to regional/county/watershed plans for protection of natural resources. The following actions are intended to initiate that process.

ACTION L11: Establish a Land Use Planner Circuit Rider

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L11: Circuit Rider	<i>Leads:</i> PADER or PADCA, DNREC, NJDEP <i>Partner:</i> Delaware Estuary Council	Short-term	\$150,000 per year

Why: Municipalities often lack the expertise and resources to try innovative approaches to land use planning.

What and How: This action would provide land use experts to develop innovative solutions to identified community land use planning needs throughout the Estuary. These individuals would actively seek out opportunities to demonstrate new techniques and transfer them to other communities. Some of the information and tools would include:

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- Comprehensive planning assistance to local governments including developing natural resource inventories
- Municipal environmental goals and objectives
- Local natural features analysis
- Assistance in amending local ordinances
- Transfer of development rights
- Build-out analysis
- Watershed modeling
- Regular updates of the Delaware Estuary Status and Trends Study prepared in 1994

The Circuit Riders would assist in implementing several actions in the Land Management Action Plan, including L8, L9, L13, and L14. Pennsylvania currently has a Circuit Rider program that provides grants for municipalities to jointly hire a professional planner, among other choices. This program should be modified to encourage its use for environmental concerns and to give priority to communities in the Delaware watershed.

Measure of Success: Circuit riders in place by October 1996.

ACTION L12: Expand Municipal Planning Grants Program

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L12: Municipal Planning Grants Program Expansion	<i>Leads:</i> State legislatures would be responsible for appropriating funding; PADCA, DNREC, and NJDEP would administer.	Short-term	Staff: \$150,000 per year Grants: \$360,000 per year

Why: One reason why municipalities fail to use innovative planning is that revisions to planning ordinances are costly.

What and How: One way to encourage improvements in the municipal planning process is to provide funding for updating municipal comprehensive plans, zoning ordinances, and subdivision regulations. All three states now provide funding for this purpose. This action seeks to increase the amount of funding and link it to consistency with county plans as described in Actions L8 and L9. The proposed one



staff person per state would be needed to oversee the administration of grants and follow up on proper implementation.



Measure of Success: Grants to at least 15 additional municipalities per state in 1996. Continuing funding until all municipalities in watershed are updated. Updates repeated on a 5-10 year cycle.

ACTION L13: Conduct Training and Workshops

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L13: Training and Workshops	<i>Lead:</i> State circuit riders <i>Partners:</i> Other state and regional agencies	Short-term	10,000 per year for meeting supplies

Why: Participants in the existing local land use planning process include professional planners, elected officials, and volunteers, all of whom could benefit from continued training and technical assistance.

What and How: This action would support frequent training and workshops, planned either as regional or county functions. Workshops should focus on innovative programs, projects, information, and strategies for implementing the CCMP Actions. Examples are as follows:

-  Offer facilitated workshops to municipalities to help them establish goals and objectives consistent with the Delaware Estuary Program goals. The formal statement of goals and objectives provides a sound basis from which to construct legally defensible ordinances to implement municipal comprehensive plans.
-  Establish and provide training for environmental commissions or environmental advisory councils, which have proven to be effective in improving consideration of environmental issues in decisions of the planning board. Once the commissions or councils are established, members need continuing support to stay current about new information, regulations, and environmental protection techniques.

Environmental commissions exist in Pennsylvania and New Jersey and could be expanded with technical support. Each state should assign responsibility for continuing education and technical support of environmental commissions to an

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existing agency. In Pennsylvania, the Department of Community Affairs serves some of these functions now, as does the State Planning Office in New Jersey.

Measure of Success: Three to four workshops conducted per state per year. Increased effectiveness of environmental commissions.

ACTION L14: Establish and/or Increase Support for Mapping/GIS Activities

Why: Municipalities need useful information on environmental hazards and natural resources at an appropriate scale.

Measure of Success: Establishment of Pennsylvania GIS by 1997. Incorporation of Program data into state GIS systems. Widespread use of GIS data by local governments.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L14: Support for Mapping/GIS Activities			
L14.1: PA Pilot System	<i>Lead:</i> PADER	Short-term	\$250,000
L14.2: Data Interpretation	<i>Leads:</i> PADER, DNREC, NJDEP	Short-term	Undetermined
L14.3: Local Government Assistance	<i>Leads:</i> RIMS, Circuit riders	Mid-term	Already provided for

Action L14.1: Establish a Pilot GIS System in Pennsylvania

What and How: States can take advantage of economies of scale in collecting data, developing geographic information systems (GIS), and producing maps. New Jersey already has an extensive GIS system that links to county government. Delaware also has a statewide GIS system, but Pennsylvania does not. GIS transfer could be enhanced in Delaware immediately. GIS development in Pennsylvania is limited only by funding and commitment. The availability of USEPA-developed land cover information may provide an impetus for further GIS development in Pennsylvania.

**Action L14.2: Increase State Efforts to Provide Environmental and Other GIS Data to Local Governments**

What and How: The Delaware Estuary Program has collected information on significant habitat, sources of toxic substances, living resources, population status and trends, and other topics related to the environment. Much of the information is available in digital form. Data from the Program and other sources needs to be interpreted to be useful to local governments. This is an appropriate role for the states. Counties could play an intermediary role. Information should flow from the states to the counties and also from the counties to the states.

Action L14.3: Help Counties Access Maps

What and How: The RIMS system manager and state circuit riders should focus efforts on helping counties to access maps in the state GIS. Another Program role would be to provide software for watershed modeling.

ACTION L15: *Develop Sustainable Development Business/Industry Incentive Programs*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L15: Sustainable Development Business/Industry Incentive Programs	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	\$50,000 for initial review of potential actions

Why: The participation of business and industry is essential to implementing sustainable development. Most members of these groups need encouragement to participate.

What and How: The concept of sustainable development requires that partnerships be developed among business, industry, government, and environmental interests. In carrying out this proposed action, the Delaware Estuary Foundation would develop a menu of incentive programs to help business and industry meet Delaware Estuary Program goals, e.g., preferred tax breaks, easements, development bonuses, and a pollution prevention advisory service. After the menu of incentive programs has been developed, the Foundation staff should meet with business and industry to identify the next steps.

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The purpose is to encourage participation of the business community in the Delaware Estuary Program, increase awareness of business and industry, and improve the linkage between environment and economics.

Measure of Success: Increased awareness within the business community of the concepts of sustainable development.



LEGISLATIVE AND REGULATORY CHANGES

These actions address specific problems identified by Delaware Estuary Program participants that require action at the state level. They seek to promote preservation of natural resources, reduce pollutant emissions, and streamline government processes.

ACTION L16: *Encourage and Support Compact Development as an Element of Comprehensive Planning for Communities*

Why: Innovative development techniques such as cluster development are difficult to implement because of inflexible regulatory programs, the legal system, and lack of public awareness.

Measure of Success: Promulgation of new regulations for utilities within two years. Subsequently, development of regional utilities to manage small wastewater systems, increase use of cluster development in a way that protects open space, and adopt municipal open space ordinances in three municipalities per state per year. Improved maintenance of open space.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L16: Compact Development as an Element of Comprehensive Planning for Communities			
L16.1: Regional Utilities	<i>Leads:</i> PADER, DNREC, NJDEP	Short-term	\$150,000 for first year
L16.2: Assignment of Maintenance Responsibility	<i>Leads:</i> Municipalities, with assistance of circuit riders	Mid-term	\$15,000 per year
L16.3: Promotion of Cluster Development	<i>Leads:</i> Circuit riders, Delaware Estuary Foundation staff	Short-term	\$10,000 per year

Compact or cluster development is one solution to the problems of suburban sprawl. Under this type of zoning, structures are confined to the most suitable portions of a particular tract, and the remaining land is preserved as open space for groundwater recharge, habitat, or recreation. While this technique offers many benefits, including providing equity for owners of sensitive land, it has shortcomings. Developers who

would like to use the technique often encounter several common barriers, including difficulty in obtaining permits for small wastewater treatment systems, problems in long-term maintenance of common land, and concerns over liability. Another issue is that cluster development, without the balance of a regional open space plan, can lead to wall-to-wall cluster developments.

Action L16.1: Develop Regional Utilities to Manage Small Wastewater Systems for Cluster Developments in Designated Growth Areas

What and How: This action proposes that each state set standards for small wastewater treatment systems, including alternative methods such as spray irrigation. The states should also set up a series of regional utilities to manage the individual wastewater systems to avoid historic problems of poor maintenance. This would require promulgation of new regulations, which could take up to two years.

Action L16.2: Implement Local Ordinances to Require that Responsibility for Maintenance is Accepted by a Responsible Organization

What and How: Where cluster developments are developed in accordance with a comprehensive or master plan which includes an open space element, the developer should be required to identify the organization that will be responsible for maintenance of the open space over the long term. The maintaining organization should formally accept the responsibility and identify a plan for funding the maintenance activities. This could be accomplished by local ordinance changes.

Action L16.3: Promote the Concept of Cluster Development through Education on New Models, Benefits to Residents, and Water Quality Benefits

What and How: Developers, home-buyers, and planning agencies often are unfamiliar with the benefits of cluster development. They need to be shown the wide variety of housing that can be considered cluster development, the economic advantages for homeowners, communities, and developers, and the environmental benefits of cluster development, such as protected open space and reduced impervious surfaces. Appropriate tools would include printed material and workshops.



ACTION L17: Develop Policies and Incentives to Encourage Redevelopment in Previously Developed Areas

Why: Existing state and federal policies tend to encourage development in open space or agricultural areas, rather than previously developed areas. This encourages fragmentation of farmland and natural areas, and abandonment of urban areas.

Measure of Success: Conduct forum within two years. Modification of at least six funding programs within four years. Increased number of redevelopment sites. Legislative amendments.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L17: Policies and Incentives to Encourage Redevelopment in Previously Developed Areas			
17.1: Tri-State Forum	<i>Leads:</i> State planning and economic development agencies <i>Partners:</i> State resource agencies, counties	Short-term	\$50,000
17.2: Evaluation of Regulatory and Funding Programs	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> State and federal resource and funding agencies	Mid-term	Undetermined

Action L17.1: Evaluate Existing Policies for Redevelopment

What and How: This action provides for the development of policies to encourage redevelopment and infill in previously developed areas rather than sprawling development that affects prime farmland and sensitive habitat areas. This should include consideration of reuse of contaminated industrial sites as well as redevelopment of existing sites that do not have contamination problems.

All three states have existing programs that provide varying levels of support for redevelopment. The states can learn from each other by jointly reviewing their programs and policies. Furthermore, both state and federal agencies can encourage redevelopment by reviewing funding and regulatory programs such as Coastal Zone Management, Clean Water Act NPDES, Small Business Administration, and enterprise zone programs.

Action L17.2: Review Regulatory and Funding Programs for Opportunities to Encourage Redevelopment

What and How: States should prepare summaries of existing policies on redevelopment for review by other states. The states would then convene a tri-state meeting, to include local governments, to evaluate existing policies for redevelopment.

The states and federal government should review and report on regulatory and funding programs for opportunities to encourage redevelopment through incentives.

ACTION L18: *Provide Financial Relief to Municipalities and Counties to Alleviate the Losses due to State Conservation Land*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION L18: Increase in In-lieu Payments	<i>Leads:</i> State legislatures, state agencies	Mid-term	\$200,000

Why: Local governments in Pennsylvania and New Jersey lose tax revenues when states acquire conservation land within their boundaries, thereby removing it from the tax rolls.

What and How: Delaware Estuary Program participants have identified many ways in which the current tax structure promotes development and discourages conservation. One concern is that local governments in Pennsylvania and New Jersey lose tax revenues when states acquire conservation land within their boundaries. This action proposes to increase payments in lieu of taxes to reduce the burden on local governments, where it can be identified that the purchase of conservation lands has a negative impact on the financial stability of the municipality.

Measure of Success: Increase in payments. Increased support of conservation by local governments.



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CHAPTER IV: Water Use Management Action Plan

The Delaware Estuary Program has endorsed two goals and several objectives that directly relate to water use management (See Introduction to Action Plans). The waters of the Delaware Estuary are the lifeline to this region. We depend on these waters for food, livelihood, commerce, transportation, and recreation. The Estuary waters are also home to thousands of fishes, birds, plants, and animals. Water management is a complex task involving numerous regulatory agencies, each trying to balance use and conservation of a specific resource in the public's interest. For proper management, many questions need to be answered. Is there adequate water supply for the 21st century and beyond? Is the water safe to swim in? Where are the public access points along the Estuary and are there enough of them? Can we form partnerships to promote the economic growth of ports while protecting the living resources of the Estuary? To begin to address some of these questions, this chapter provides a summary of issues and recommendations for three key aspects of water use management: water supply, port/navigation activities, and public access and recreational activities.

Water management is a complex task involving numerous regulatory agencies, each trying to balance use and conservation of a specific resource in the public's interest.

A. Water Supply

PROBLEM STATEMENT

Because of the large demands on the Basin's water resources from 20 million users, problems exist, including periodic basinwide water supply shortages (as described in Chapter II) and regional groundwater overdrafts. The Potomac Raritan—Magothy (PRM) aquifer in the New Jersey Coastal Plain and the Triassic Lowlands in southeastern Pennsylvania are the most stressed groundwater systems.

An emerging problem is the depletion of tributary streamflows stemming from expanded water supply development and interbasin transfers of wastewater.



DIMINUTION OF TRIBUTARY STREAMFLOWS

Urbanization and expanded water development have profoundly affected the stream environments of tributary watersheds draining to the Delaware Estuary. Large-scale pumping from wells, in conjunction with the export of sewage, has diverted significant quantities of water from their normal path of discharge to surface streams and redistributed this water in both space and time, creating extreme low-flow and no-flow conditions in many former perennial streams and stream segments. This redistribution of water and interbasin transfer of wastewater interferes with instream and downstream water uses, adversely affects fisheries and aquatic life, and reduces the capacity of streams to assimilate natural and human related pollutants from point and nonpoint sources. It also has increased the potential for groundwater contamination through infiltration from groundwater pumping.

While stream diminution problems are widespread in the Estuary region, there is very little data documenting the scope of this diminution. In order to provide such documentation, it is necessary to know the availability of ground and surface water, the points and quantities of withdrawals, and the destination and discharge points of wastewater. Unfortunately these data are not conveniently available, since they are in different databases managed by different water resource agencies. In recognition of this problem, DRBC contracted with the U.S. Geological Survey (USGS) to develop a water management model for the Neshaminy Creek Basin as a pilot program. The model will calculate withdrawals, discharges, and interbasin transfers, and the relation between withdrawals and availability, including base flows. Once developed, the methodology will be available for use in other tributary watersheds of the Estuary.

INCREASING WATER DEMANDS

Because of increasing population and development in the Basin, consumptive water use is projected to increase from 344 mgd in 1990 to 440 mgd by the year 2020 (See Chapter II for further details). Total water withdrawals in the Basin averaged more than 7.3 billion gallons per day in 1991, most of which is returned and is available for reuse. Two systems, however, are particularly stressed: the Potomac Raritan-Magothy Aquifer and the Triassic Lowlands.

Potomac Raritan-Magothy (PRM) Aquifer

The principal source of water supply, historically, for industrial and municipal needs in Camden, Gloucester, and Burlington Counties, New Jersey has been the PRM aquifer. In its natural state, the aquifer discharged an estimated 50 mgd of fresh water to the surface waterways in the three-county area, including the Delaware Estuary. With increased municipal and industrial development, withdrawals have exceeded the natural recharge from precipitation. Fresh water flows to the Estuary have ceased in many areas, and the aquifer is now recharged from the Estuary and nearby streams to a significant degree. Based on studies by DRBC and USGS, water levels in large parts of the aquifer already have been lowered over 90 feet below sea level and at current rates are continuing to decline, threatening the safe and dependable yield of the aquifer. The aquifer is also threatened by the upconing of deeper saltwater and the inland movement of the saltwater-freshwater transition zone.

In October 1986, the New Jersey Department of Environmental Protection (NJDEP) established Water Supply Critical Area No.2, which required water allocation permittees to reduce the amount of water they were withdrawing from the PRM aquifer. In April 1989, the Appellate Division of the Superior Court of New Jersey determined that NJDEP did not have statutory authority to order reductions in withdrawals. In January 1993, NJDEP reestablished Water Supply Critical Area No. 2. The July 1993 amendments to the New Jersey Water Supply Management Act reinforced NJDEP's action and provided specific formulas for determining base allocations and reductions in groundwater withdrawals for water allocation permittees.

The New Jersey American Water Company is constructing a water supply project to provide surface water for customers in Burlington, Camden, and Gloucester Counties. This project, known as the Tri-County Water Supply Project, was endorsed by NJDEP in its Camden Metropolitan Water Supply Feasibility Study. Water will be taken from the Delaware River, treated, and distributed throughout the Tri-County area. The water treatment plant is expected to have an initial capacity of 30 mgd.

In accordance with July 1993 amendments to the Water Supply Management Act and NJDEP's directives, the Department is now requiring all permittees in the Critical Area to develop an alternative water supply plan. The selected alternative(s) must be implemented by September 15, 1995.



Triassic Lowlands

The Triassic Lowlands portion of the Piedmont subprovince includes the Pennsylvania counties of Bucks and Montgomery and portions of Berks, Chester, and Lehigh Counties, as well as parts of Hunterdon and Mercer Counties in New Jersey. The 1,140 square mile area is characterized by its crystalline and sedimentary rocks of Triassic age (180-230 million years old) including diabase, shale, basalt, and sandstone. Although these rock formations contain some good yielding aquifers, they store and transmit considerably less water than the Coastal Plain aquifers. Many areas overlying the Triassic Lowlands have experienced very rapid development since 1950 and have relied almost entirely on groundwater. In recent years, many water purveyors and individual homeowners have experienced water shortages because of increased water demands and several cycles of sub-normal precipitation which resulted in lowered water tables.

A special regulatory program aimed at controlling the overuse of groundwater in the Triassic Lowlands portion of Pennsylvania was instituted by DRBC in 1981. The groundwater "protected area" comprises all of Montgomery County, 36 municipalities in Bucks County, 25 communities in southern and northern Chester County, three townships in eastern Berks County, and one in southern Lehigh County. All new groundwater withdrawals in the protected area that withdraw an average of more than 10,000 gallons per day (gpd) are subject to special regulations. Any new or enlarged withdrawal, of 10,000 gpd or more, requires a DRBC permit before going into operation. Withdrawal applications must include a written report by a hydrogeologist on the anticipated effects of the proposed withdrawal on existing wells, the flow of perennial streams, and groundwater levels; the results of an extended pump test and a complete well log; demonstration that the reliable yield of the groundwater basin or aquifer will not be exceeded; and demonstration that existing surface and groundwater withdrawals will not be adversely impacted. Also required are metering of water connections and conjunctive use of ground and surface water, water conservation, consideration of interconnections with adjacent water systems, and a drought emergency plan.

In August 1989, the Point Pleasant Water Diversion Project became operational. It withdraws surface water from the Delaware River for use in Bucks and Montgomery Counties. The water supply component of the project, known as Forest Park Water, provides significant opportunities for conjunctive use of surface and groundwater. However, very few water utilities have taken advantage of this additional supply. The region remains

overly dependent on the Triassic aquifers, potentially jeopardizing long-term supplies.

B. Ports and Navigation

PORT HISTORY

Port complexes have historically been the anchors for large waterside communities, which have flourished around superior water routes and trade accessibility. Prior to the development of modern transportation technologies, such as air, rail, and highway, waterborne transportation was of primary importance for both trade and development. Early in America's history, the Delaware River inspired the funding and growth of Philadelphia, as a major gateway to world markets and cultures.

VALUE OF THE PORT/REGIONAL ECONOMIC IMPACTS

The Ports of Philadelphia, Camden, Gloucester City, Salem, and Wilmington contribute significantly to the regional economy and affect the daily lives of many Estuary residents. Many industrial plants are dependent on the Ports for importing and exporting materials to and from the region. This movement of products adds significantly to the economy. Ranked second in the Nation in total waterborne commerce, the Port complex generates an income of over \$3 billion and 180,000 jobs.

In 1987, Philadelphia ranked first among the mid-Atlantic ports in the amount of tonnage handled, and it has consistently been near the top. From 1982 to 1992, foreign tonnage moving through the

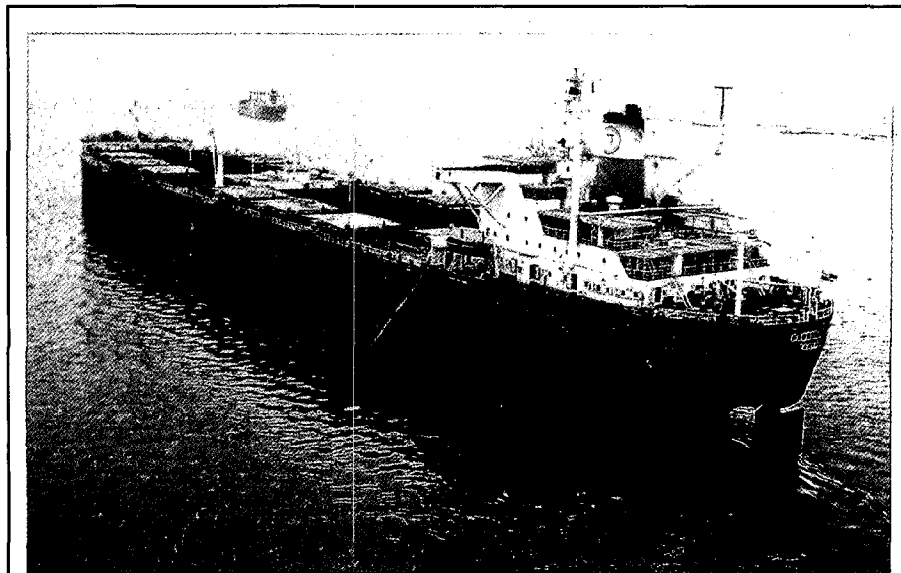


Figure 36. Aerial view of a tanker on the Delaware River. (Photo Bill Buchanan)



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Philadelphia Ports increased 37.5 percent, from 47.2 million tons to nearly 58 million tons. Also, gains in cargo tonnage have been maintained in Philadelphia, not fluctuating as in other ports.

The Port complex handles more than 63 million tons of international cargo annually, including iron and steel, fruits and vegetables, paper, wood, lumber and cork, chemicals, cocoa products, and meat. It handles more Chilean and Australian beef than any other port in the Nation, and it ranks second only to the Gulf region in crude oil imports. For example, in 1985, of the 56,067,266 tons of bulk cargo imported to the complex, 44,684,839 tons were petroleum products.

With so much of the regional economy dependent on Port-related activities, keeping the shipping channel clear for navigation is a vital task. The U.S. Army Corps of Engineers (USACE) must dredge the channel almost continuously. These activities can often create engineering and dredged material disposal problems.

PORT NEEDS

Port investments and services support regional efforts to compete in a global economy. Ports help to maintain the economic stability of the region by creating jobs, increasing industrial efficiencies, adding to productivity, and providing high level services to the region to attract new business and industrial opportunities.

In order to continue these important services and uses, long-term Port management is essential. Funding for better facility planning, improved road access, and improved dredging techniques have been addressed and supported by the federal government. Continued public-private partnerships, which support terminal expansions and rail clearances, are vital to generating the renewal of the transportation industry in the region.

In our support of the transportation industry and its renewed growth, we must also consider related environmental impacts in the region and the need to move toward a sustainable society. Businesses, industry, governments, and citizens are working in partnership to find a common ground in order to sustain both our economic and environmental futures. These efforts are facilitated through cooperative ventures and programs such as Delaware Estuary Program.

**Port
investments
and services
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regional
efforts to
compete in a
global
economy.**

C. Public Access and Recreational Use

PUBLIC USE OF THE ESTUARY

The overall theme of the Delaware Estuary Program is "Discover its Secrets". The Estuary region holds a multitude of both "treasures" and "secrets" that are available for public use. From birding at the Cohansey River, south to Cape May; to lying on the beaches at Lewes, Delaware; from boating in the upper reaches of the Bay at Mad Horse Creek; to attending cultural events at Penns Landing and the Camden Aquarium; to riding or walking along the trails at numerous points in the region — the Estuary has recreational uses for just about everyone.

Providing these opportunities through an unrestricted waterfront helps to instill a sense of ownership and, in turn, a sense of stewardship among citizens. These attitudes help generate support for necessary policies and plans and help to change **c o n s u m p t i v e** behaviors that can have detrimental impacts on the Estuary.

PUBLIC ACCESS

Broadly defined, public access to the waterfront means the ability to see the water's edge and to be physically able to move freely to, from, and along the water. This opportunity to explore and enjoy the environment is a pivotal factor in an improved quality of life for the citizens of the region. Quality of life improvements



Figure 37. Public access, often in the form of corridors to the water and along the waterfront, provides an opportunity to learn about the rich natural and cultural diversity of the area.



include: opportunities for fitness, stress reduction, and spiritual renewal; opportunities to foster family and community values and public events; and opportunities for economic development through tourism and ecotourism. Conversely, lack of public access limits the public's exposure to or use of the Estuary, reducing interest in the Estuary and willingness to take action in the fostering and care of the Estuary. The issue of security is often raised in discussions about public access opportunities. Water-dependent commercial activities along the waterfront frequently have legitimate concerns about liability and insurance. In areas where there is a mixture of water-dependent, water-oriented, and adaptive reuse activities, there can be friction about public access for these reasons.

Despite the constraints that can occur along the waterfront, the Delaware Estuary, its tributaries, and their associated natural and man-made features are resources that can be shared and enjoyed by the public in numerous ways. One of the objectives of the Delaware Estuary Program is to ensure that sufficient, appropriate, and safe waterfront open space and public access areas will be reserved and preserved for existing and future public use, and that adequate facilities will be provided to meet the recreational demands of the public without impairing the natural resources of the region. Waterfront and public access areas should be managed and allocated judiciously for the enjoyment of our generation and the generations to come.

RECREATIONAL USE

Closely tied to public access is recreational use of the Estuary. Recreational activities such as walking, boating, swimming, fishing, canoeing, camping, and water skiing are just a few of the favorite pastimes enjoyed by citizens in the region. The Delaware Estuary offers a wide variety of these activities along its banks and shores. Public facility areas, such as national, state, county,

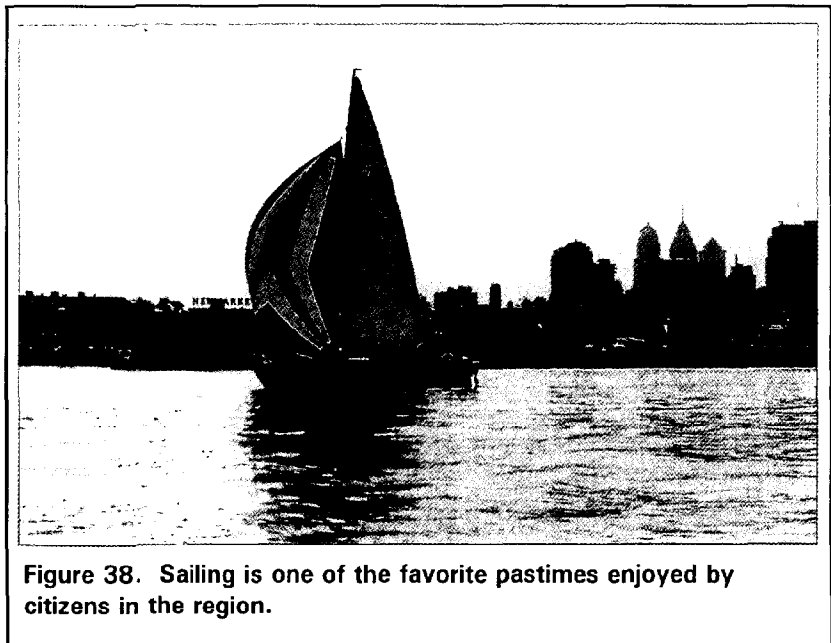


Figure 38. Sailing is one of the favorite pastimes enjoyed by citizens in the region.

and municipal parks and greenways, are designed to provide prime waterfront locations for recreational activities. Maintaining and enhancing these recreational opportunities are vital to the restoration efforts for the Estuary. The improvement in Delaware Estuary water quality has dramatically increased recreational activities in the region although, as noted in the State of the Estuary, Chapter II, portions of the Estuary do not meet the Clean Water Act goals of "fishable/swimmable". Water quality improvements have also provided economic opportunities to Estuary communities; however, proper management of recreational activities and increased educational efforts are needed to prevent new stresses to the Estuary. Recreational and sporting groups are among the most ardent supporters of the Estuary and sponsor public education and awareness activities on the need for protection of the Estuary's natural resources. In addition to these groups, increased management attention from government, businesses, and citizens is needed to address protection issues and to resolve conflicts between recreational uses in some areas.

Improving recreational access and activities in the Estuary is an important step in increasing ownership and stewardship among area residents and visitors. The union of education, access, and recreational use increases public awareness of Estuary resources and the need to protect them. Ultimately, an emphasis on improving and managing recreational opportunities related to the Estuary can be a key to its protection.

Ultimately, an emphasis on improving and managing recreational opportunities related to the Estuary can be a key to its protection.



Recommendations

ACTION W1: Promote Implementation of Water Conservation Rate Structures/Conservation Retrofitting Programs by Water/Wastewater Utilities

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W1: Utility Water Conservation Rate Structures/ Conservation Retrofitting Programs	Lead: DRBC	Short-term	\$80,000 for staff and to prepare manuals and software

Why: Reducing water use through water conservation can delay or eliminate the need for developing new water supplies or enlarging existing supplies. It can lead to a direct reduction in per capita generation of wastewater, thereby enabling sewage treatment plants to process waste from more homes and businesses. It can also eliminate the need for constructing new plants or expanding existing plants. Water saved during both normal times and drought periods improves a water utility's ability to deal with drought conditions. The financial impacts of water conservation are all positive: savings in capital costs; savings in long-term water and sewer bills; and drought preparedness.

What and How: DRBC Resolution No. 92-2 requires water utilities seeking Commission approval for a new or expanded water withdrawal to submit a water conservation plan with their applications. Applicants that withdraw an average of one mgd or more are also required to include in the plan 1) an evaluation of the feasibility of implementing a water conservation pricing structure if one has not been adopted and 2) information on the water utility's program to provide information on the availability of water-conserving devices and products. Most water utilities will not be affected by Resolution No.92-2 because it applies only to new and expanded water withdrawals. Also, the regulation does not apply to wastewater utilities.

This action would include the preparation of a technical guidance manual and computer software for water and wastewater utilities seeking to adopt conservation rates. Suitable retrofit manuals already exist. The proposed action would also provide

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for distributing these manuals and supporting material to over 300 utilities in the Estuary region and conducting follow-up workshops. Implementation of water conservation rate structures and retrofitting programs would occur at the local level by water and wastewater utilities.

Measure of Success: Preparation of technical guidance manual. Adoption of water conservation rate structures and retrofitting programs by water and wastewater utilities by 1997.

ACTION W2: Encourage Adoption of Water Conservation Fixture Standards in Pennsylvania

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W2: Water Conservation Fixture Standards in Pennsylvania	<i>Leads:</i> Pennsylvania municipalities, Commonwealth of Pennsylvania <i>Partners:</i> DRBC, Delaware Estuary Foundation	Short-term	\$10,000

Why: Reducing water use through installation of water conserving plumbing fixtures will provide significant economic and environmental benefits: improved drought preparedness, savings in capital costs, and reduced long-term water and sewer bills (See Action W1).

What and How: This action would encourage Pennsylvania municipalities to adopt water conservation ordinances as required by DRBC in Resolution No. 88-2 (Rev.2), and encourage the Commonwealth of Pennsylvania to adopt statewide water conservation standards for plumbing fixtures and fittings. The Delaware Estuary Foundation and staff could assist with outreach efforts and technical assistance in rewriting ordinances for municipalities (See Action L11).

The DRBC Resolution requires municipalities in the Pennsylvania portion of the Basin to adopt water conservation performance standards for plumbing fixtures and fittings. Municipalities in Delaware and New Jersey were not required to adopt the standards because both states had adopted statewide standards. No statewide standards exist in Pennsylvania. As of October 4, 1994, 175 out of 230 municipalities in the five Estuary watershed counties had adopted the required local ordinances. Approximately 24 percent are not in compliance. For municipalities lacking a plumbing or building inspector, there may be increased enforcement costs.



Measure of Success: Adoption of local water conservation ordinances in five municipalities per year in the Estuary watershed or adoption of statewide standards for the Commonwealth of Pennsylvania by December 1995.

ACTION W3: Conduct Modeling Studies for Tributary Watersheds Experiencing Stream Diminution Problems

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W3: Modeling Studies for Stream Diminution Problems	<i>Leads:</i> DRBC, PADER, DNREC, NJDEP	Short-term	Approximately \$25,000 per watershed, depending upon size and data requirements

Why: This action would lead to an improved understanding of stream diminution problems in the Estuary stemming from water development and interbasin transfers of water and wastewater.

What and How: With the completion of the water management model for the Neshaminy Creek Basin, DRBC will have a prototype model for stream diminution that would be transferable to other tributary watersheds. The model allows quick access to groundwater and surface water withdrawal, groundwater availability, wastewater discharge, and interbasin transfer data. It also presents GIS coverages for calculating and displaying drainage areas, geology, and groundwater pumpage zones.

The following watersheds have been identified by DRBC as experiencing some stream diminution problems and should be considered for additional modeling studies:



Delaware—Christina River, Red Clay Creek, White Clay Creek



Pennsylvania—Crum Creek, Darby Creek, Pennypack Creek, Perkiomen Creek, Ridley Creek, Skippack Creek, Wissahickon Creek



New Jersey—Big Timber Creek, Cooper River, Little Ease Run, Little Timber Creek, Mantua Creek, Newton Creek, Pennsauken Creek, Scotland Run, Squankum Branch, Woodbury Creek

The model is an important tool for evaluating the inter-relationships of water quality and quantity for tributary watersheds and evaluating conjunctive water use options.

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Results of modeling studies would provide data and information for use by water and wastewater utilities and county and municipal planning agencies to fully consider sustainable development concerns in future plans and projects. The results of the modeling studies would be available for dissemination to interested groups and individuals.

Measure of Success: Initiation of additional modeling studies, with a goal of one or more watersheds per year.



ACTION W4: Encourage Water Utilities to Utilize Water Conservation Techniques and Conjunctive Use Methods to Prevent Long-term Lowering of Groundwater Levels

Why: The Potomac-Raritan-Magothy (PRM) aquifer in the New Jersey Coastal Plain and the Triassic aquifers in southeastern Pennsylvania are the most stressed groundwater systems in the Basin. These systems are characterized by regional groundwater overdrafts. This action would prevent long-term lowering of groundwater levels and protect the safe and dependable yield of the PRM and Triassic aquifers for present and future generations.

Measure of Success: Implementation by water utilities of the recommended alternative sources of supply to supplement their base allocation of the PRM by September 15, 1995. Support of DRBC efforts, by the Delaware Estuary Foundation, to disseminate information on water conservation by water utilities. Purchase of additional water needs from surface water sources. Interconnection with surface water supplies.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W4: Use of Water Conservation Techniques by Water Utilities			
W4.1: Supplements to Base Allocations from PRM Aquifer	<i>Leads:</i> NJDEP, Water utilities, Delaware Estuary Foundation	Short-term	Approximately \$7,500 for staff, workshops, material
W4.2: Decreased Reliance on Triassic Aquifers	<i>Leads:</i> DRBC, Water utilities, Delaware Estuary Foundation	Short-term	See W1; project costs (Forest Park Water) defrayed through water sales

The Delaware Estuary Foundation would support and assist water utilities to use water conservation techniques through sponsored workshops and information dissemination. NJDEP and DRBC would continue to encourage water conservation and conjunctive use methods through their ongoing regulatory and technical assistance functions.

WATER USE MANAGEMENT

Action W4.1 Encourage Water Utilities Withdrawing from the PRM Aquifer to Supplement Base Allocations

What and How: In accordance with the July 1993 amendments to the Water Supply Management Act and NJDEP's directives, all affected permittees are required to supplement their base allocation from the PRM Aquifer through one or more of the following alternatives:



Additional water conservation programs



Purchase of water from the Tri-County Water Supply Project, either directly or through NJDEP's water credit transfer program (project costs for the Tri-County Water Supply Project built by New Jersey American Water Company will be defrayed through water sales to water utilities).



Purchase of a portion of another water user's base allocation

Action W4.2 Encourage Water Utilities Withdrawing from the Triassic Aquifer to Reduce their Over-reliance on these Aquifers

What and How: Water utilities would be encouraged to reduce their over-reliance on these aquifers by:



Implementing additional water conservation programs



Purchasing water from Forest Park Water or other surface water sources



Improving reliability by conducting conjunctive use of ground and surface water

ACTION W5: Encourage the Reuse of Wastewater for Nonpotable Purposes

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W5: Wastewater Reuse for Nonpotable Purposes	<i>Leads:</i> Water users, golf courses, industries, commercial enterprises	Short-term	Undetermined

Why: Because of increasing population and development in the Basin, the demand for water for public supply, commercial, and power generation uses is increasing. Unless



mitigated through water conservation methods, increasing demands for water will complicate the resolution of water supply problems in the PRM and the Triassic Lowlands aquifers.

What and How: As another form of water conservation, this action would prevent the long-term lowering of groundwater levels and protect the safe and dependable yield of the PRM and Triassic aquifers for present and future generations. The Delaware Estuary Council and Foundation should support efforts underway that promote the reuse of wastewater to reduce future water withdrawal demands. For example, after secondary treatment, wastewater could be used for irrigating golf course fairways, tees, and greens. This common practice of reuse of wastewater saves withdrawing from potable sources of water supply.

Measure of Success: Decreased reliance on potable water supplies.

ACTION W6: *Encourage Water and Wastewater Utilities to Conduct Integrated Resource Plans*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W6: Integrated Resource Plans	<i>Leads:</i> DRBC, Delaware Estuary Foundation, PADER, DNREC, NJDEP	Mid-term	\$20,000

Why: As a way to alleviate stream diminution, Integrated Resource Planning (IRP) by water and wastewater utilities and counties offers an opportunity for improved coordination of water supply and wastewater planning and facility design.

What and How: The lack of coordinated water supply and wastewater planning has led to water quantity problems that must be addressed by federal, regional, and state agencies. One of the most significant problems in the Estuary is the diminution of tributary streams stemming from water supply development and interbasin transfer of wastewater (See Action W3). IRP by water and wastewater utilities and counties offers an opportunity for improved coordination of water supply and wastewater planning and facility design, and the consideration of resource management concerns such as instream flow protection. Traditional planning approaches have failed to consider these broader concerns.

IRP includes planning methods to identify the most efficient means of achieving goals while considering project impacts on community and environmental management objectives. These planning methods specifically require evaluation of all benefits and

WATER USE MANAGEMENT

costs, including avoided costs, externalities, and life cycle costs. A primary tenet of IRP is that planning should be conducted in an open and participatory process. Accordingly, water and wastewater utilities should include all levels of government in their IRP efforts, rather than limiting these efforts to the affected water and wastewater utilities.

In order to encourage the preparation of IRPs by water and wastewater utilities and counties, DRBC, in coordination with the Foundation, should sponsor a two-day workshop to provide hands-on training for the conduct of IRP. Numerous IRP handbooks are available to assist in IRP development. The American Water Works Association has published Integrated Resource Planning Guidelines (December 1993). In 1995, the AWWA Research Foundation also will publish a Handbook on Integrated Resource Planning. All water and wastewater utilities in the Estuary region would be encouraged to attend.

Measure of Success: Conduct two-day workshop for water and wastewater utilities and counties. Preparation and implementation of IRPs by water and wastewater utilities and counties.

ACTION W7: *Encourage Implementation of the Remaining Provisions of the "Good Faith Agreement" and Support Additional Efforts to Ensure Freshwater Flows to the Estuary to Meet Water Supply Needs to the Year 2020*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W7: Freshwater Flows	<i>Leads:</i> Delaware Estuary Foundation, DRBC, states, USACE	Short-term	\$2,500

Why: Preparing for basinwide shortages is crucial to the health of the residents and the natural resources of the Estuary.

What and How: The Delaware River Basin experiences, on average, three droughts every ten years. Preparing for basinwide shortages is crucial to the health of the residents and the natural resources of the Estuary. DRBC, as the primary planning and regulatory authority for water supply, has a balanced water supply program. This program includes water conservation, drought management, and supply development. The "Good Faith Agreement" (see p. 27) includes 14 recommendations for a balanced water supply program that addresses these elements. A balanced water supply program would augment freshwater flows to the Estuary; help restore and protect aquatic resources; reduce the threat of saltwater contamination of the PRM aquifer;



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improve public health due to reduced ingestion of sodium and chlorides; and provide water to offset present and future consumptive uses and enhance regional water supplies. The Delaware Estuary Foundation would periodically evaluate, monitor, and support the progress of efforts made toward the provision for freshwater flows.

Measure of Success: Implementation of a balanced water supply program leading to: reduced drought emergencies; increased freshwater flows; safe levels of sodium in drinking water; and more reliable water supplies.

ACTION W8: *Coordinate Dredging Activities and Priorities and the Management of Dredged Material Within the Region*

Why: Port investments and services support not only the regional economy in the three states but also help us compete in a global economy. Continued port competitiveness is a shared vision among many different community interests. In the past 10 years, imports and exports moving through the Ports of the Delaware River increased 37.5 percent, from approximately 47 million tons to nearly 58 million tons per year. Recreational use of the River and Bay has also increased over recent years. For safe operation of vessels on the Delaware, dredging is a necessity. Dredging within the Delaware River and Bay removes in excess of six million cubic yards of material annually at a cost of \$15 to \$18 million.

Measure of Success: Predictable standards for the dredging process within the Estuary completed by 2000. Continued access to recreational areas that have silted in over the past years through state sponsored maintenance dredging programs that allow for reassessment of dredging locations and priorities at least every five years. An informed public on the continued maintenance and proposed dredging process in the Estuary. A long-term management plan for the use of dredged material by 2000.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W8: Coordinated Dredging Activities and Dredged Material Management			
W8.1: Coordinated Regulatory Process	<i>Leads:</i> USACE, USEPA, marina operators and owners, Delaware Estuary Council	Short-term	\$37,500 per year
W8.2: Access to High Use Recreational Areas	<i>Leads:</i> USACE, states, marina and boater associations	Short-term	\$5,000 per year
W8.3: Information Exchange on New Dredging Projects	<i>Leads:</i> Delaware Estuary Foundation, USACE	Short-term	\$25,000 per year
W8.4: Dredged Material Management Plan	<i>Leads:</i> Federal, state, and local governments, nongovernment advocacy groups, Delaware Estuary Council	Short-term	\$150,000



Action W8.1 Coordinate the Regulatory Process for Maintenance Dredging among the Three States to Make the Process More Uniform and Predictable

What and How: Safe navigation within the Delaware Estuary is assured by periodic maintenance dredging which provides access for many types of vessels using the waters of the River and Bay complex. This action provides for coordinated regulatory decision protocols among the three states to ensure protection of living resources and public health, and to make the process more uniform and reliable.

Action W8.2: Maintain Access to High Use Recreational Areas

What and How: Siltation and shoaling of the river bottom affects not only those portions of the River and Bay used by commercial ship traffic (and is subject to maintenance dredging by USACE and state waterways maintenance offices) but also marinas, tributaries, and high use recreation areas used by recreational boaters. Currently, opportunities exist to periodically "piggy back" privately sponsored maintenance dredging activities on state and federal projects. These are, however, deemed insufficient by the pleasure boater community. There is a need for additional state sponsored projects to maintain access to recreational areas, but this need must be balanced with the need to protect shallow water habitats. The dredging of new areas must also be distinguished from boaters' ideas about areas near state maintained channels where additional and expanded dredging is desirable. This action proposes significant participation by the pleasure boating community in a multi-year reassessment and planning process.

Action W8.3: Facilitate Information Exchange on New Dredging Projects that have Regional Impacts

What and How: This action recommends that the Delaware Estuary Foundation serve as a forum for disseminating information on new dredging projects, such as the Delaware River Main Channel Deepening Project and other such projects that have a regional impact to the Estuary. The Regional Information Management Service (See Chapter IX) should be used as a vehicle to distribute this information. In order for ports to remain competitive, continued maintenance of the main navigation channel is necessary. In addition to maintenance, the Delaware River Main Channel Deepening Project, from 40 to 45 feet, was authorized by Congress for construction as part of the Water Resources Act of 1992. The project is currently in the Pre-Construction Phase of development. Continued close coordination with USACE is necessary to ensure the protection of living resources. The Delaware Estuary Council should act as a facilitator of information within the region on projects, and be used to gather feedback from the general public concerning that information.

Action W8.4: Develop a Long-term Management Plan for Dredged Material

What and How: Disposal of dredged material, including clean dredged material, is becoming more problematic as environmentally preferred disposal sites for this material are diminishing. New sites and methods of disposing of dredged material need to be identified. Beneficial uses of dredged material may present an opportunity to allow for both dredging as well as creation of habitat. This action recommends that the Delaware Estuary Council support efforts for the development of a long-term management plan that addresses the need for dredged material disposal, beneficial use, habitat protection, decommissioning of sites, proper disposal of contaminated sediment, and related issues.

As part of long-term management plan development, the process should:



Develop a map of areas that will need continued maintenance dredging and proposed new dredging over the next 20 years and potential dredged material disposal and stockpile sites.



Conduct an environmental assessment study, including National Environmental Policy Act (NEPA) documentation on the dredged material and dredged material disposal sites, and, if warranted, prepare an Environmental Impact Statement (EIS).



Identify specific sites where habitat creation is appropriate with dredged material. For example, clean dredged materials should be encouraged for beach restoration/protection of small beaches along the Lower Bay. The importance of these beaches includes both natural and economic values.



Develop an agreement among the three states and the federal government on the uses of dredged material that would include an approach to valuing habitats relative to each other. While this would not be a binding decision, it would lay the groundwork for more efficiently deciding what types of habitats are desirable to create in which parts of the Estuary.

USACE has expressed interest in carrying out restoration activities. Under Section 22 of the Water Resources Development Act of 1974, there is a program which allows for a 50/50 cost share for planning for water resource related problems. Other programs exist which may also be utilized, but all require cost sharing.

Current USACE authorities are specific in requiring a non-federal sponsor to pay for any additional costs above that associated with the least cost option. The non-federal sponsor must assume responsibility for the site after construction.



ACTION W9: Utilize RIMS for Information Management that Facilitates Port Operations and Safety

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W9: Information Management to Facilitate Port Operations	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Maritime exchange, business and industry, watershed organizations, local governments	Short-term	See RIMS (Chapter IX)

Why: There is a need for information to be disseminated from one source. The Delaware Estuary Foundation should act as a central network to simplify, clarify, coordinate, and communicate information, regulations, complaints, or other requests for assistance to citizens.

What and How: The Regional Information Management Service (RIMS) recommendation (See Actions in Chapter IX) should satisfy and fulfill these expectations. In order for this to occur, RIMS must be able to network with and through already existing information centers. One opportunity for this coordination to occur is through the Maritime Exchange for the Delaware River and Bay (Maritime Exchange). For a primary source of information, the Maritime Exchange has already established a solid network of private and public port businesses, government agencies, and others.

One of primary missions of the Maritime Exchange has been to promote navigational safety throughout the channel. This includes providing such services as relaying docking and other instructions to vessel operators, distributing navigation restriction and other similar notices throughout the tri-state port community, and working closely with the Pilots' Association to promote and improve vessel traffic information systems. As part of their effort, the Maritime Exchange maintains and supports the Transport Release Automated Cargo Status (TRACS) and the Sensitive Cargo Tracking System. In the TRACS system, instantaneous information on cargo release and automated system status is provided to receivers, whereas the Sensitive Cargo Program coordinates important product profile information to the U.S. Coast Guard, again instantaneously on petroleum cargoes transiting the Delaware Estuary.

The Delaware Estuary Program should promote coordination and partnerships among the various information collectors, suppliers, and distributors in order to add value to the protection of the Estuary and facilitation of Port operations through RIMS.

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Measure of Success: Successful implementation of RIMS. Improved response time to citizen inquiries. Successful partnerships formed within the Delaware Estuary watershed.

ACTION W10: Support Private Sector Efforts on Oil Spill Response and Pollution Prevention

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W10: Private Sector Efforts on Oil Spill Response/ Pollution Prevention	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> DBRC, MSRC, USEPA, marina and boater associations, local governments, general public	Mid-term	\$10,000 plus staff time

Why: This action would acknowledge and support private sector efforts to minimize the risk of oil spills and identify opportunities for partnerships with the Delaware Estuary Foundation to increase efforts in pollution prevention, such as the Marine Spill Response Corporation and Delaware Bay and River Cooperative.

What and How: The Foundation should assist marina owners in identifying funding sources that would allow them to purchase oil recovery and collection booms for the protection of boats within the marina. Pollution prevention measures in marinas would include information on and the implementation of the Coastal Nonpoint Pollution Control Program. In addition, as citizens of the Estuary are often the first to discover hazardous spills, an advisory alert network consisting of primary contacts in the event of a spill should be broadly advertised and be easy and simple to use. In the case of major hazardous discharges, a multi-media alert should be broadcasted via television, radio, newspapers, computer billboards, VHF-FM Marine radio (via USCG), state and local marine police, and other enforcement and protective agencies, that can quickly implement advisory alerts and bulletins.

Measure of Success: Decreased response time and increased attention to and awareness of hazardous discharges to the Estuary. A more knowledgeable public as to who to contact in the event of a hazardous spill. Protection of boats within marinas from a major hazardous spill and implementation of pollution prevention techniques.



ACTION W11: Develop, Publish, and Implement a Comprehensive Public Access Management Strategy

Why: Better water quality and a growing coastal population have led to a demand for increased public awareness concerning public access for a variety of recreational uses, including power and non-power boating, swimming, fishing, rowing, canoeing, kayaking, water skiing, etc. This action would lead to the development of a comprehensive inventory of current and projected public access points within the Delaware Estuary, to communicate information to the public, and to provide a base for future planning and facility needs. Increased planning for and development of better public access facilities for the citizenry of the Delaware Estuary watershed is needed.

Measure of Success: Development, implementation, and broad distribution of a complete Comprehensive Public Access Resource Document for the Delaware Estuary watershed by 1998.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W11: Comprehensive Public Access Management Strategy			
W11.1: Inventory of Public Access Points	<i>Lead:</i> Delaware Estuary Council/Foundation <i>Partners:</i> National Park Service, State coastal zone programs, counties, municipalities, non-profit organizations, recreational organizations	Mid-term	\$75,000 to \$100,000 for a one-time publication
W11.2: Listing of Regional Public Access Deficiencies and Concerns	<i>Lead:</i> Delaware Estuary Council/Foundation <i>Partners:</i> National Park Service, State coastal zone programs, counties, municipalities, non-profit organizations, recreational organizations	Mid-term	\$100,000
W11.3: Public Access Management Issues and Appropriate Tools	<i>Lead:</i> State coastal zone management programs	Mid-term	\$25,000
W11.4: Funding for Future Public Access Facilities	<i>Lead:</i> Delaware Estuary Council, state legislatures	Mid- to long-term	To be determined

Action W11.1: Develop an Inventory of Public Access Points within the Estuary

What and How: An inventory would be the first step in the development of a Comprehensive Public Access Resource Document. This could be accomplished under the Coastal Zone Management Act (Section 309), for projects of special merit. The inventory should contain information on access for a variety of recreational users. In addition, launching ramps, parking lots for tow vehicles and non-boaters, as well as a listing of pump-out stations should be included in the inventory.

This activity could be integrated into the Delaware Estuary Program RIMS to allow continually updated information to be added.

Action W11.2: Develop a Prioritized Listing of Regional Public Access Deficiencies and Concerns

What and How: This action would set up an analysis of the Public Access Inventory and develop a prioritized listing of regional public access deficiencies and concerns. The listing should be coordinated with greenways planning and provide for careful evaluation of sensitive sites. County master plans should be reviewed as well as ongoing regional efforts.

Action W11.3 Identify Management-related Issues associated with Public Access and appropriate Tools for Addressing the Issues

What and How: This action would identify all management-related issues associated with the public access deficiencies in Action W11.2 and the appropriate tools for addressing these issues, such as land acquisition, zoning, accessway designs, and funding sources, to be compiled in a methods manual. This is primarily an effort to transfer information from other states and programs. The circuit riders called for in L11 could coordinate this effort.

Action W11.4 Establish a Stable Source of Funding for Future Public Access Facilities

What and How: This action would establish a stable source of funding for local, county, and state agencies for public open space acquisition, facility development or redevelopment, and the operation and maintenance of public access facilities.

Lack of funding could result in the deterioration of existing facilities, as well as failure to develop new facilities to meet the needs of a growing coastal population. Legislation for a permanent source of funds for acquisition, development, operation, and maintenance needs would help meet the goals of the Delaware Estuary Program.



ACTION W12: Inventory Available Pump-Out Stations and Address Any Identified Deficiencies

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W12: Pump-Out Stations Inventory	<i>Leads:</i> PA, NJ, DE, USFWS, Delaware Estuary Council, and other nongovernment organizations.	Short-term	\$75,000 - \$100,000

Why: This action would address the need for additional pump-out facilities and encourage their use by the general public

What and How: This action would inventory the number of pump-out stations available to boaters in the Estuary for the discharge of onboard sewage (liquid waste). Deficiencies would be identified and addressed through the installation, approval, and operation of pump-out facilities, and encouraging the use of facilities by the general boating public by making them easy, convenient, and free or inexpensive to use. Possible locations for these facilities include fuel docks, marinas, service, and launching areas. Owners of older boats would be encouraged to purchase equipment needed to use the pump-out stations. This action would be coordinated with projects proposed or underway through the Clean Vessel Act.

Measure of Success: Improved water quality conditions due to reduced waste discharge from boaters directly into the Estuary. Every marina with 50 or more berths available has a pump-out facility installed by the year 2000. Supports implementation of the Coastal Nonpoint Pollution Control Program.

ACTION W13: Develop and Implement Strategies to Achieve the "Fishable/Swimmable" Goals of the Clean Water Act

Why: Segments of the Estuary are below the goals of the Clean Water Act. One of the causes is the existence of CSOs in the urban section of the river. DRBC, USEPA, the states, and the four city/urban areas with CSOs are developing a CSO control strategy. Models are being used to assess the relationship between wet weather events and combined sewer system responses and to predict the effects of operational as well as physical changes to the combined sewer systems to mitigate wet weather discharges. A significant issue in developing this strategy is the currently used water quality model — Dynamic Estuary Model (DEM). As a result of differences between predicted values and field data, a full reevaluation of the model was conducted. It has been recommended that the DEM model be replaced with a new model that can better predict wastewater discharge impacts at low flow conditions and CSO impacts during storm conditions. Actions W13.1, W13.2, and W13.3 are recommended to complete the strategy. Completion of these actions may eventually allow the water quality standard for the urban section of the river to be raised.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION W13: Strategies to Achieve "Fishable/ Swimmable" Goals of the Clean Water Act			
W13.1: DEM Model Replacement	<i>Lead:</i> DRBC <i>Partners:</i> USEPA, DNREC, PADER, NJDEP	Short-term	\$375,000
W13.2: Control Strategies for Wastewater Facilities and CSOs	<i>Lead:</i> DRBC <i>Partners:</i> USEPA, DNREC, PADER, NJDEP, Philadelphia, Camden, Wilmington, DELCORA, CCMUA	Short-term	\$250,000
W13.3: Strategy Implementation	<i>Lead:</i> DRBC <i>Partners:</i> USEPA, DNREC, PADER, NJDEP	Mid-term	\$100,000

Measure of Success: Entire reach of Delaware Estuary is 100% fishable/swimmable through: replacement of DEM by October 1997; development of wastewater facility/CSO control strategy by October 1999; and longer term implementation of control strategies.



Action W13.1: Replace DEM Model

What and How: DRBC is working with the states and USEPA to develop a new water quality computer model that will more accurately predict the response of the river to discharges in both dry and wet weather conditions. The new model should be completed in approximately two years.

Action W13.2: Develop Control Strategies for Wastewater Facilities and CSOs

What and How: The CSO owners, with the assistance of DRBC, are now developing strategies for reducing the impacts of wet weather overflows to the river. Control measures called for in the strategy would become part of discharge permits for the CSOs. The new river model will help in the development and evaluation of the control measures.

Action W13.3: Implement Strategy

What and How: Once the strategy is developed and the actions become part of permits, the CSO owners would implement the necessary physical and operational changes to reduce the impacts of the discharges to the Estuary.

CHAPTER V: Habitat and Living Resources Action Plan

It would be difficult to overstate the importance of the habitat and living resources in the Delaware Estuary. Approximately 784,000 acres (317,280 hectares) of wetlands and openwater habitats are available to support the living resources of the Estuary. Half a million waterfowl, millions of shorebirds (Clark et al., 1993) and songbirds, half a million seabirds (Kerlinger, 1994), over 100,000 raptors, plus migrating whales, sea turtles, and anadromous fish (DRBFWMC, 1985) all use the Estuary's habitats at critical times during their migrations. Thousands of more species, many of which are less charismatic but no less important, do not migrate but live in a variety of terrestrial, freshwater, brackish, and saltwater habitats year round. These living resources and the habitats that they rely upon have long been recognized as important by local residents who utilize them for subsistence, income, and recreation. More recently, many of the wetland habitats have been recognized as being of international importance for shorebirds migrating from South America to North America (Ramsar Convention, 1992). The status and trends of many of the species for which data are available is presented in the State of the Estuary, Chapter II.

**Approximate-
ly 784,000
acres of
wetlands and
openwater
habitats are
available to
support the
living
resources of
the Estuary.**

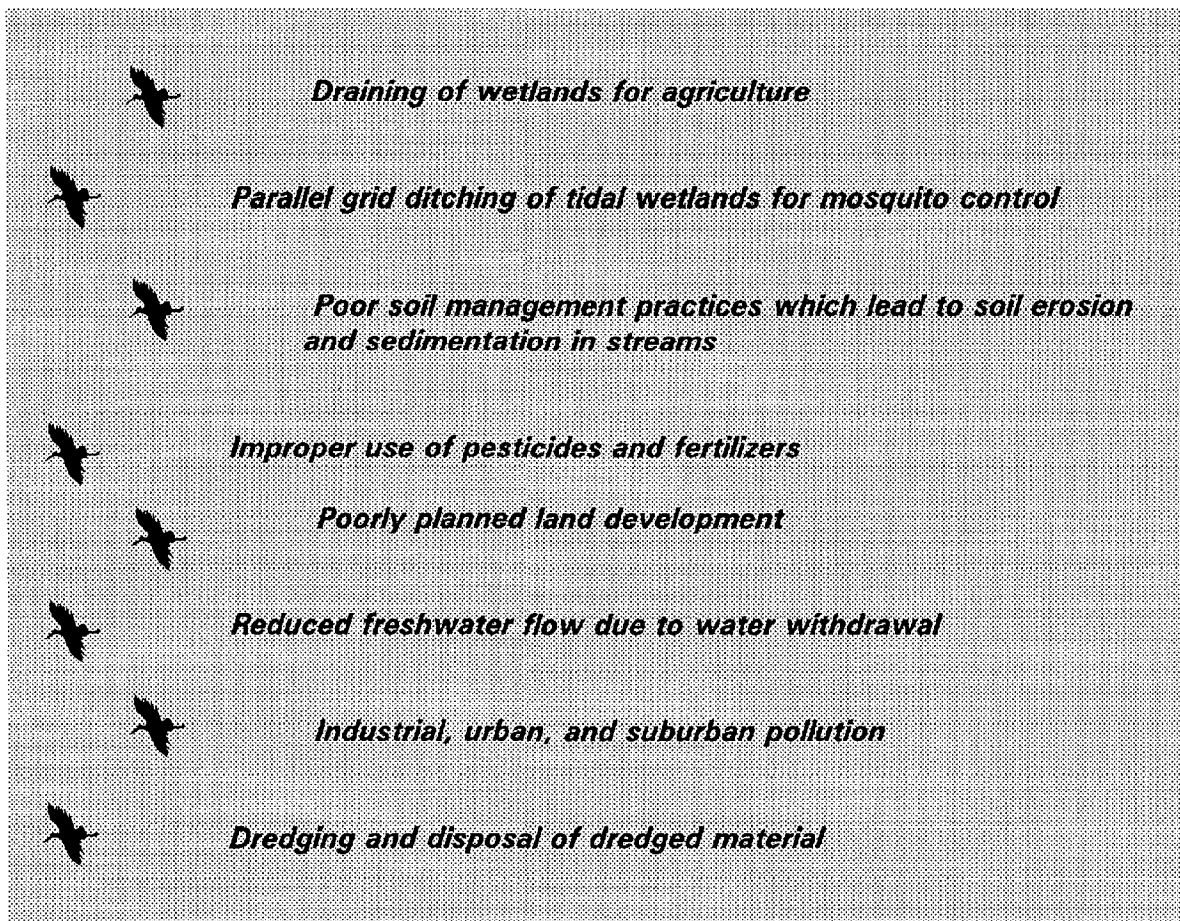
The juxtaposition of such biological richness and diversity with the intense human uses of the Estuary is one of the factors that makes the Delaware Estuary so unique. It also makes it vulnerable. A catastrophic spill of toxic substances in the Delaware during shorebird migration could impact up to two-thirds of the entire western hemisphere population of the red knot, as well as the populations of other shorebird species and horseshoe crabs. It is important that plans be in place to reduce the effects of these incidents (See Action H8).

The quality of human life is related to the health of the habitats around us. Wetlands in particular possess natural functions which maintain human and estuarine health. Flood storage and conveyance, barriers to waves and erosion, sediment control, pollution control, water supply and quality, nutrient sources for fisheries, and food production are some of the benefits. In addition, recreational activities such as fishing, waterfowl hunting, and bird and wildlife observation depend on healthy wetland habitats. Upland natural areas, such as forests and fields, provide habitat for many more species, recreational opportunities for



people, and porous surfaces that absorb and filter runoff. As development in the watershed continues and the percentage of asphalt and other impervious surfaces increases, the remaining natural areas will play a greater role in controlling nonpoint source pollution. All of the Delaware Estuary's habitats provide open space, aesthetic value, education and research opportunities, and even historical and archaeological value to the people living in the watershed.

In spite of their importance to a healthy ecosystem and high quality of life for humans, many of the habitats in the Delaware Estuary have been degraded or destroyed. In addition to the issues mentioned in the State of the Estuary Chapter II and in the sections above, Delaware Estuary habitats have been degraded by the following:



These issues are addressed by the action plans throughout this document.

A. Conserving Habitat

One of the most effective ways of conserving upland and wetland habitats, and the species that rely on them, is through acquisition by organizations and agencies whose missions include habitat protection. Figure 39 illustrates the federal, state, and county protected lands. Acquisition, however, is very expensive, works in a piecemeal fashion, and is not always welcomed by towns and counties that rely on the development of land to produce taxes. In all cases, a well thought out master plan that considers sustainable development and encourages habitat protection should be pursued (See Actions L1, L6, L8, L11, L16).

The long term habitat needs for 200 species and the most significant habitat areas are currently being mapped as a part of the Delaware Estuary Program and will be available to help prepare updated master plans. Figure 40 is an example of these maps. In addition, state Natural Heritage Programs are working towards mapping "natural communities" so that the status of these areas can be tracked in an effort to maintain biodiversity (See Action H3).

There are many opportunities to enhance and conserve habitat and living resources on lands that are not held exclusively for that purpose. Private citizens can maintain habitats on their own land and, in some cases, can get technical and financial assistance from programs such as the USFWS Partners for Wildlife program or various Soil Conservation Service programs. Owners of land containing significant habitat who wish to conserve it may be eligible to sell or transfer development rights for a portion of the land (See Actions L6, L11, L16). Figure 41 illustrates some of the areas that have already been identified for enhancement or are being considered for enhancement. Such enhancements could also include reforestation and restoration of tidal marsh impoundments (See Action H5). *Phragmites* (common reed), an undesirable plant species that has been spreading rapidly in Estuary wetlands in the past 40 years, can be targeted by state and federal resource agencies for restoration back to more typical wetland vegetation. Figure 42 illustrates the extent of the *Phragmites* in wetlands in the State of Delaware. Similar invasions have occurred in New Jersey and, to a lesser degree, in Pennsylvania.



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Federal, State, and County Protected Open Space

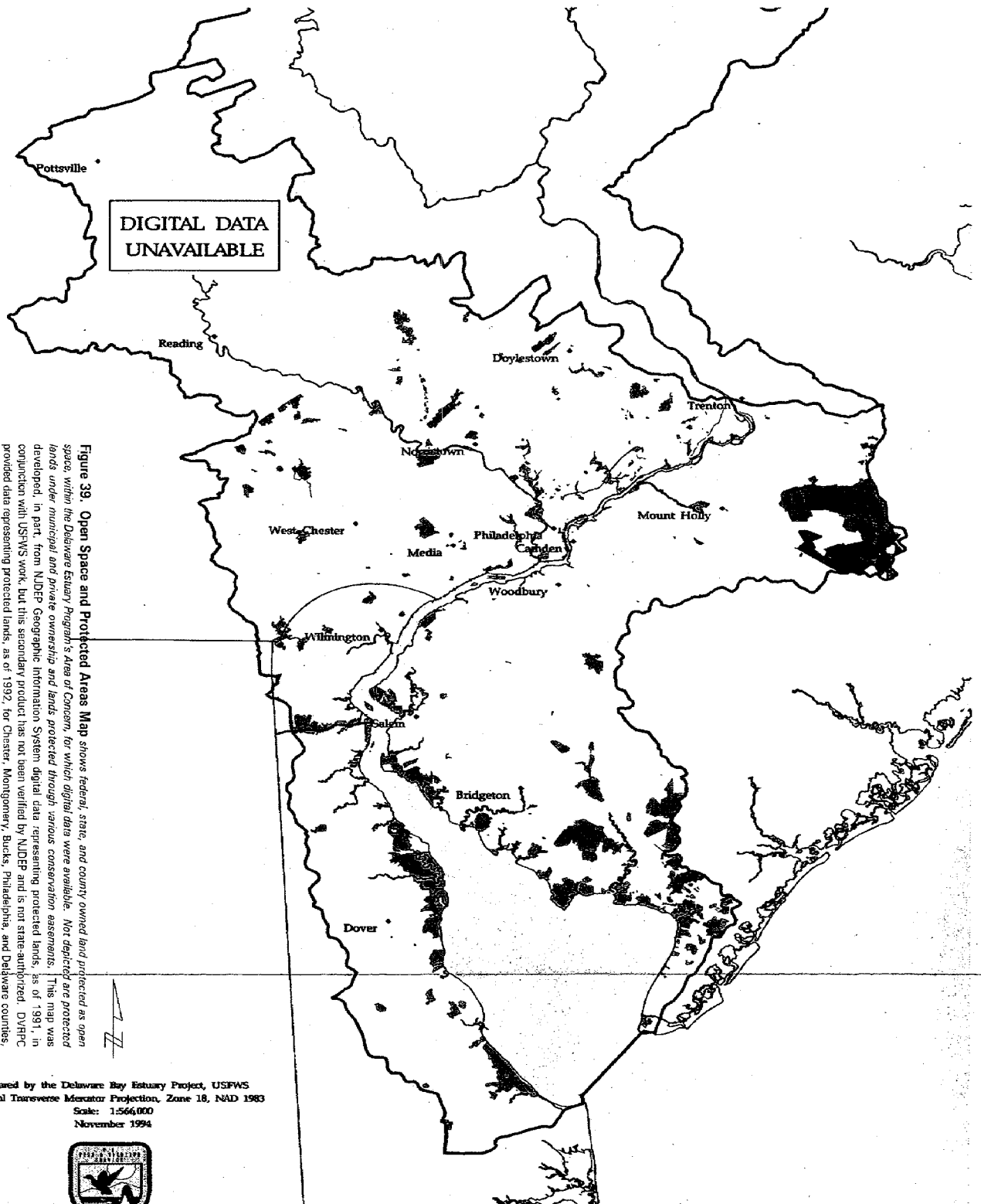


Figure 39. Open Space and Protected Areas Map shows federal, state, and county owned land protected as open space, within the Delaware Estuary Program's Area of Concern, for which digital data were available. Not depicted are protected lands under municipal and private ownership and lands protected through various conservation easements. This map was developed, in part, from NDEP Geographic Information System digital data representing protected lands, as of 1991, in conjunction with USFWS work, but this secondary product has not been verified by NDEP and is not state-authored. DWR/C provided data representing protected lands, as of 1992, for Chester, Montgomery, Bucks, Philadelphia, and Delaware counties, Pennsylvania. The Natural Lands Trust, Inc. of Philadelphia Conservationists, Inc. provided data representing protected lands, as of 1992, for Delaware. Delaware Division of Parks and Recreation reviewed the data for suitability of use in this illustrative map. Land acquisition is an ongoing process, being carried out by a variety of governmental and non-governmental entities. For up to date information, it is necessary to contact these organizations directly.

Prepared by the Delaware Bay Estuary Project, USFWS
Universal Transverse Mercator Projection, Zone 18, NAD 1983
Scale: 1:564,000
November 1994



Blue Crab (*Callinectes sapidus*) Habitat

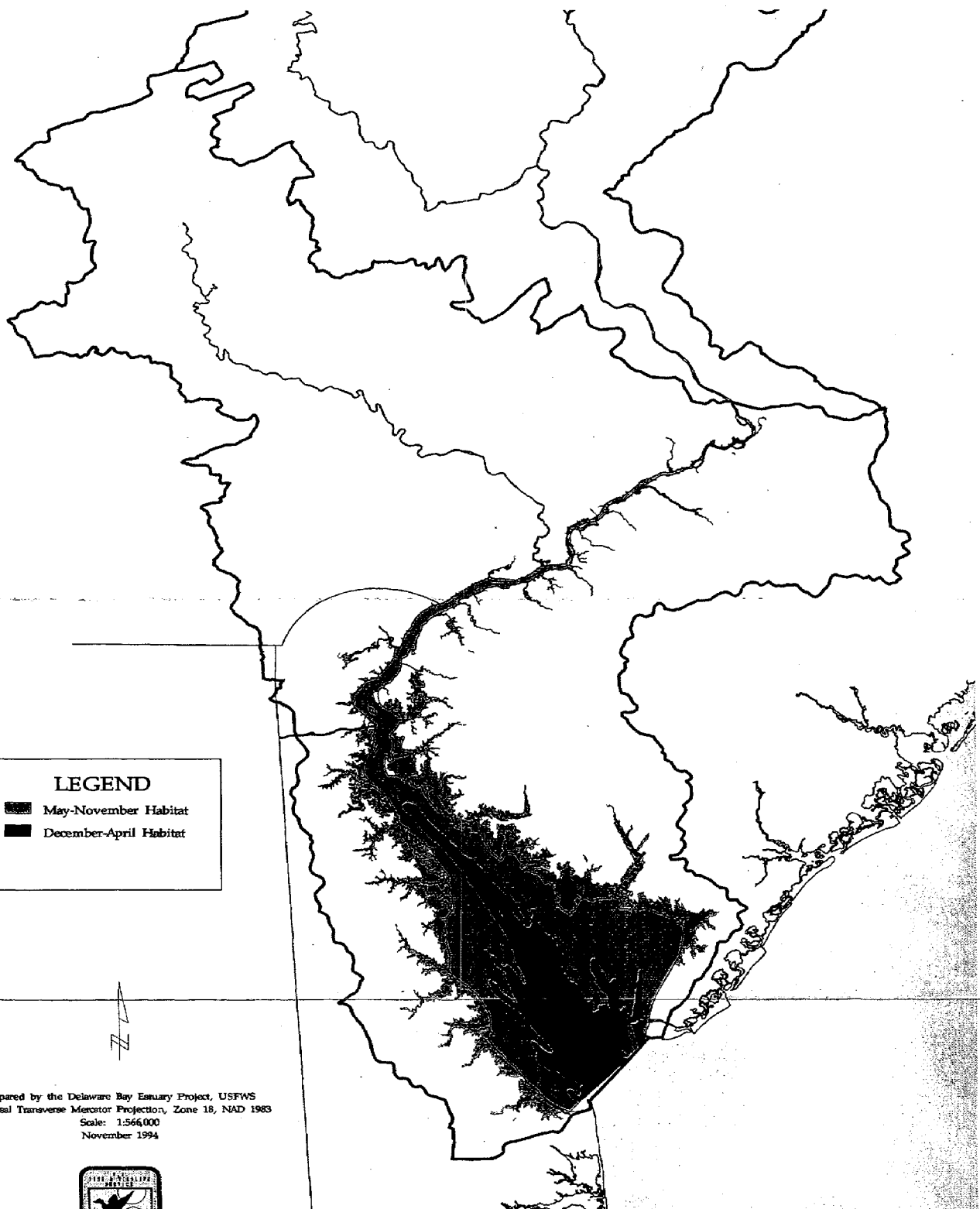


Figure 40. Blue Crab Areas Map shows the long term habitat needs of blue crabs (*Callinectes sapidus*) derived from USFWS National Wetland Inventory digital data and NOAA bathymetry data. This map was developed, in part, using NJDEP Geographic Information System digital data representing protected lands, as of 1991, in conjunction with USFWS work, but this secondary product has not been verified by NJDEP and is not state-authorized.

American Shad Restoration Potential Lower Delaware River Watershed

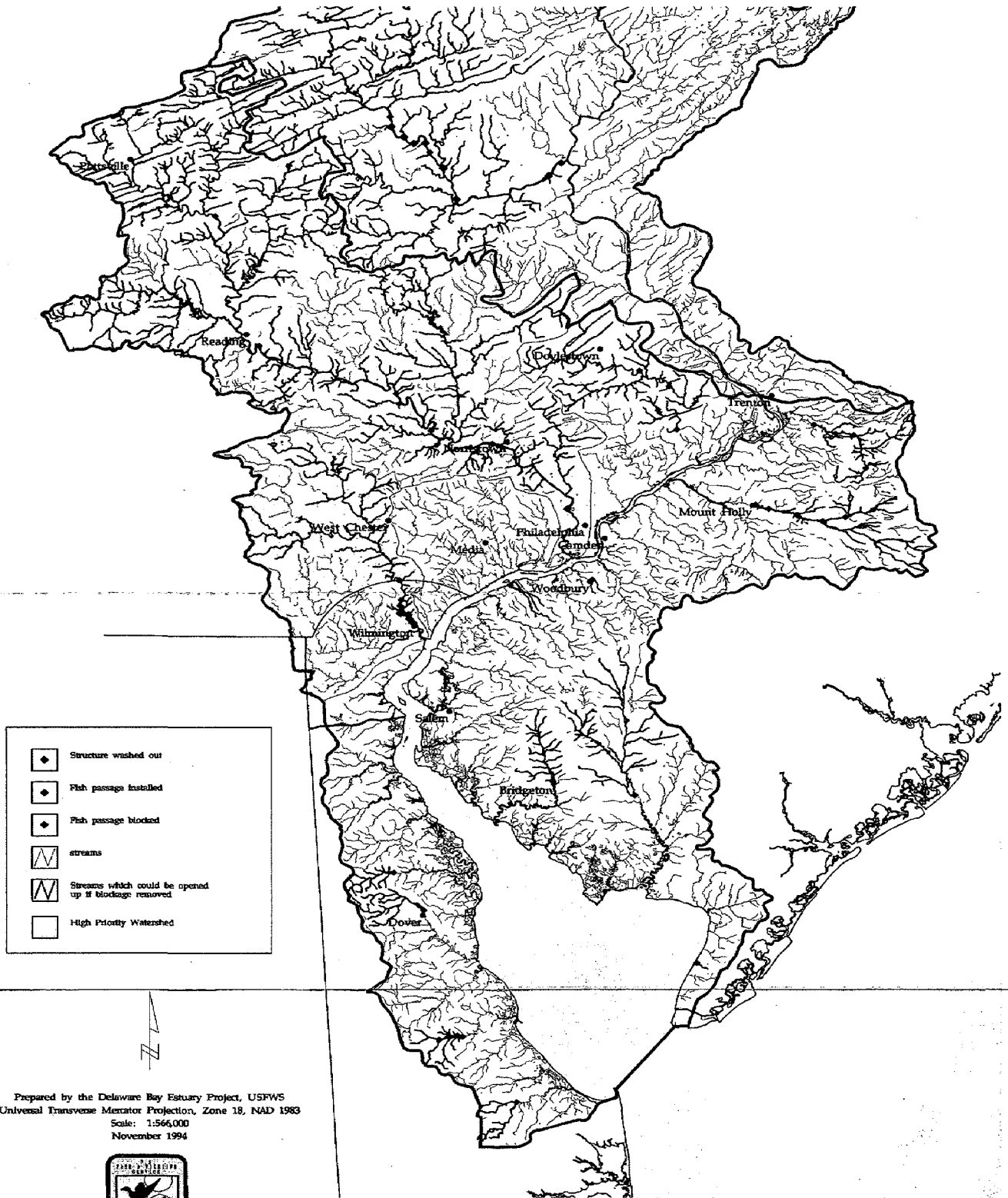


Figure 41. Opportunities for Enhancement Map shows opportunities and priorities for restoring American shad (*Alosa sapidissima*) populations using fish passages at dam sites within the Area of Concern based on the report, "A Review and Recommendations Relating to Fishways within the Delaware Basin", August 1985. This map was developed, in part, from NJDEP Geographic Information System digital data. Restoration of American shad will also benefit other fish species, including striped bass.

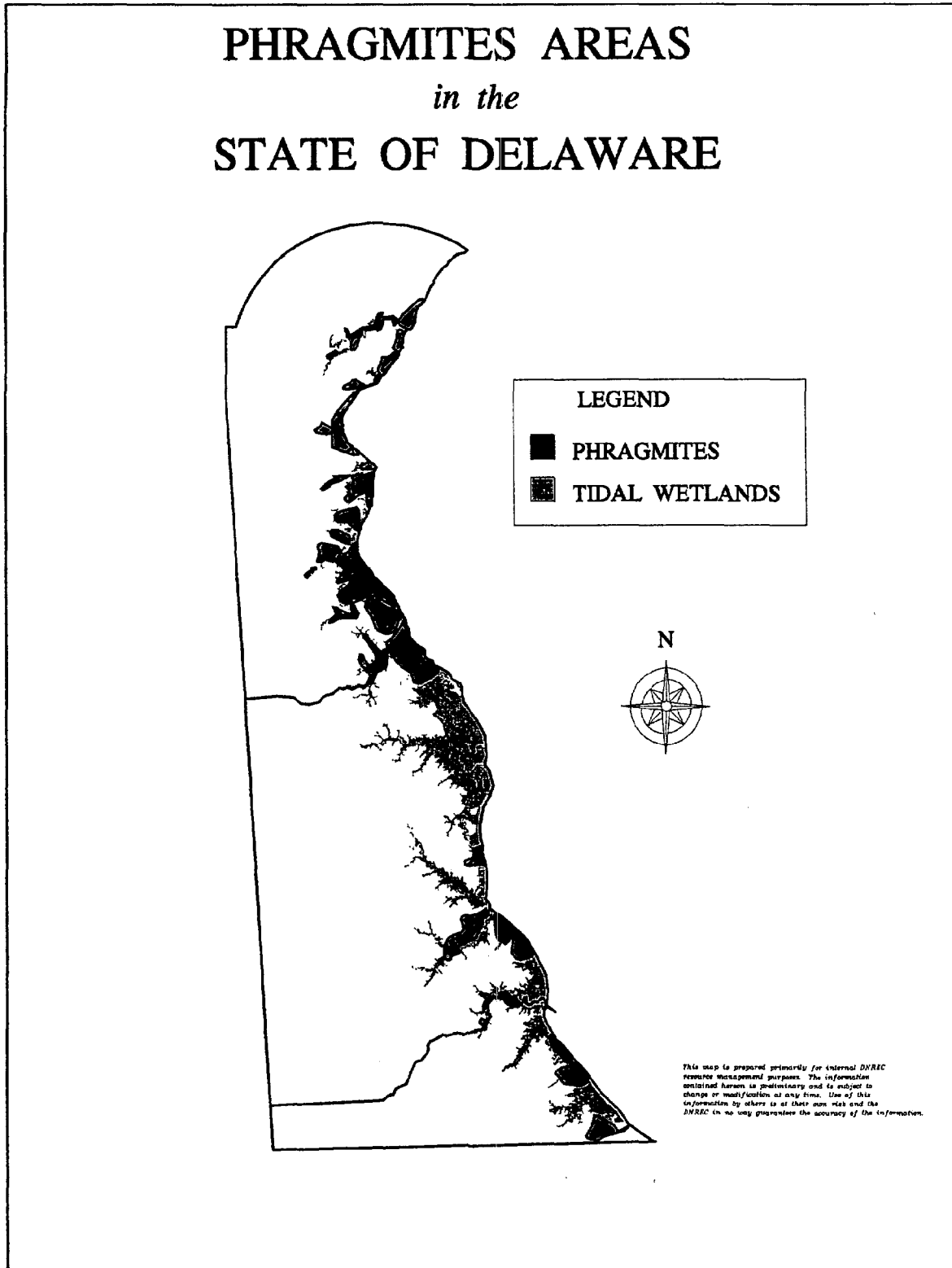


Figure 42. Extent of *Phragmites* in Wetlands in the State of Delaware Map depicts wetlands in the State of Delaware that are affected by *Phragmites* invasion. Source of data is DNREC – Comprehensive Conservation and Management Plan for Delaware’s Tidal Wetlands, 1993.



State and federal regulatory programs are also viable means of conserving habitat and living resources. Many of these are cited in the Base Program Inventory (a companion document to this Plan) or are discussed in the analysis of regulatory programs in this chapter and in the Land Management chapter (Chapter III). Actions for species management plans are presented in Actions H1 and H2, and wetlands management in Action H4.

As discussed in the State of the Estuary (Chapter II), sea level rise could cause loss or a shift in the location of coastal habitats. As sea level rises some tidal marshes may undergo increased rates of inundation and flooding, while others may appear to migrate landward (replacing low lying uplands as these areas are flooded), or become infilled with sediments (Philipp 1994). These issues need to be taken into account when managing the coastal zone (See Action H7).

B. Analysis of Existing Regulatory Programs for Habitat and Living Resources

A listing of the major state and federal programs that deal with habitat and living resources is available in a companion document to this Plan, the Base Program Inventory. This section discusses the findings of the Delaware Estuary Program's analysis of relevant programs as a basis for proposed actions.

REGULATORY PROGRAMS

Tidal wetlands, freshwater wetlands in some areas, riparian zones, significant benthic communities (oyster and clam beds), submerged aquatic vegetation, and habitats used by rare and endangered species have some regulatory protection, which could minimize future losses from manmade and natural causes. However, many of the existing regulatory programs are facing problems from: 1) inadequate funding levels; 2) lack of routine compliance enforcement; and 3) lack of clear, coordinated Estuary-wide resource management strategies (except for those issues covered by DRBC, such as flow management, water supply, and water quality). Below is a discussion of the regulatory programs that are addressed in the action plans.

WETLANDS

In some cases, federal and state programs for protecting wetlands are not well coordinated between states, nor are they

jurisdictionally consistent. New Jersey and Pennsylvania, for example, both have freshwater wetlands programs, but only New Jersey has encompassed wetland buffers into its permitting program. Delaware has a tidal program, but it has no state freshwater wetland law. On the federal side, the Philadelphia District of USACE administers the tidal and nontidal segments of the Clean Water Act Section 404 permit program in Pennsylvania and Delaware; in New Jersey, USACE also administers the tidal portion, but the state administers the nontidal portion with oversight from USEPA. At best, these inconsistencies result in a diverse approach to wetland protection that may or may not enhance the biological resources of the Estuary. At worst, this approach results in a fragmentation of wetland resources in the Estuary, with a corresponding decline in wildlife support and water quality in the region. Four reports have been published documenting the trends in wetland protection. The three state-wide reports, covering Pennsylvania (Tiner 1990), New Jersey (Tiner 1985a), and Delaware (Tiner 1985b), are consistent in showing that, since the early 1970s, there has been a dramatic reduction in coastal tidal wetland loss. However, non-tidal wetlands continue to be lost. The most recent report available, for Cape May County and vicinity (Tiner and Smith 1993), confirms this view and details the losses more precisely, concluding that, "From 1984 to 1991, forested wetlands suffered the greatest impacts of vegetated wetland types, largely due to the construction of housing developments" (See Figure 43). While it is not imperative that the programs be exactly the same, they should be coordinated to achieve a common goal. An overall management plan needs to be developed that establishes a clear wetland protection direction for the various entities within the Estuary (See Action H4).

Other problems also need to be addressed. These include the continued loss of wetland resources due to unauthorized activities and the potential cumulative effects of wetland losses from the issuance of nationwide permits for small encroachments, particularly Nationwide Permit 26 of Section 404 of the Clean Water Act. This USACE issued permit allows for the filling of wetlands under one acre in size without requiring the applicant to undergo the usual predischARGE notification procedures. In addition, the federal wetlands program under the Clean Water Act is designed to protect water quality and focuses on the removal or discharge of material in wetlands. It does not prevent the removal of trees and other vegetation which can have significant adverse effects on the wetland. Further, proactive measures to simulate planned wetland creation, restoration, and mitigation



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Cape May County and Vicinity Wetland Trends

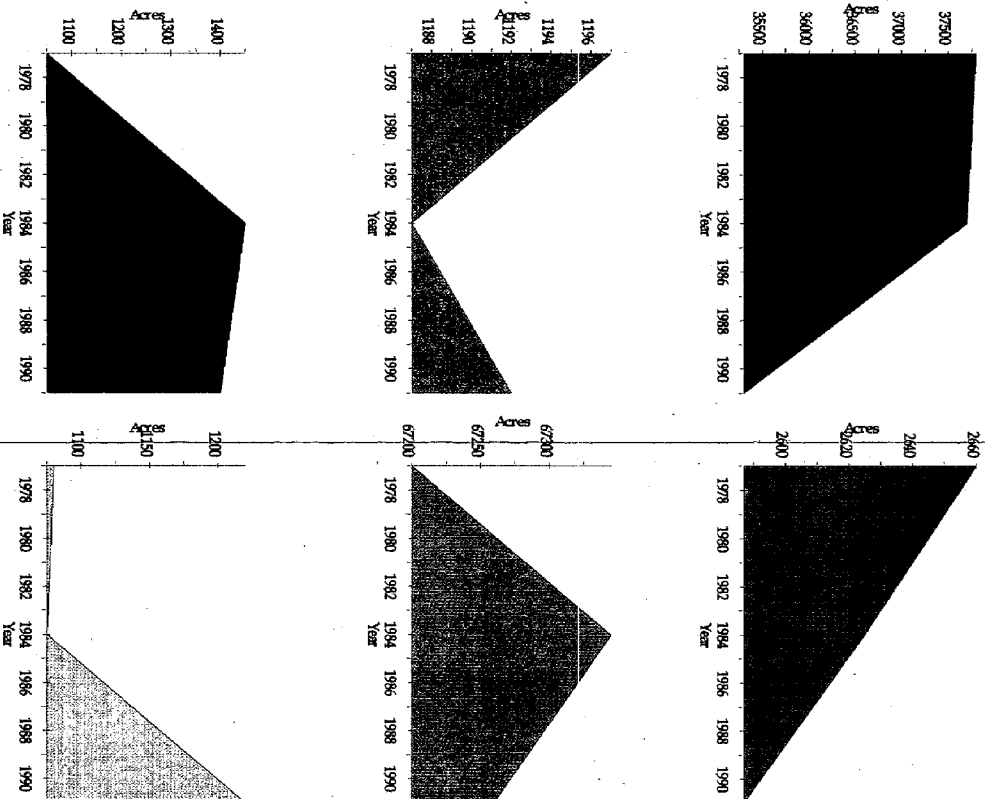
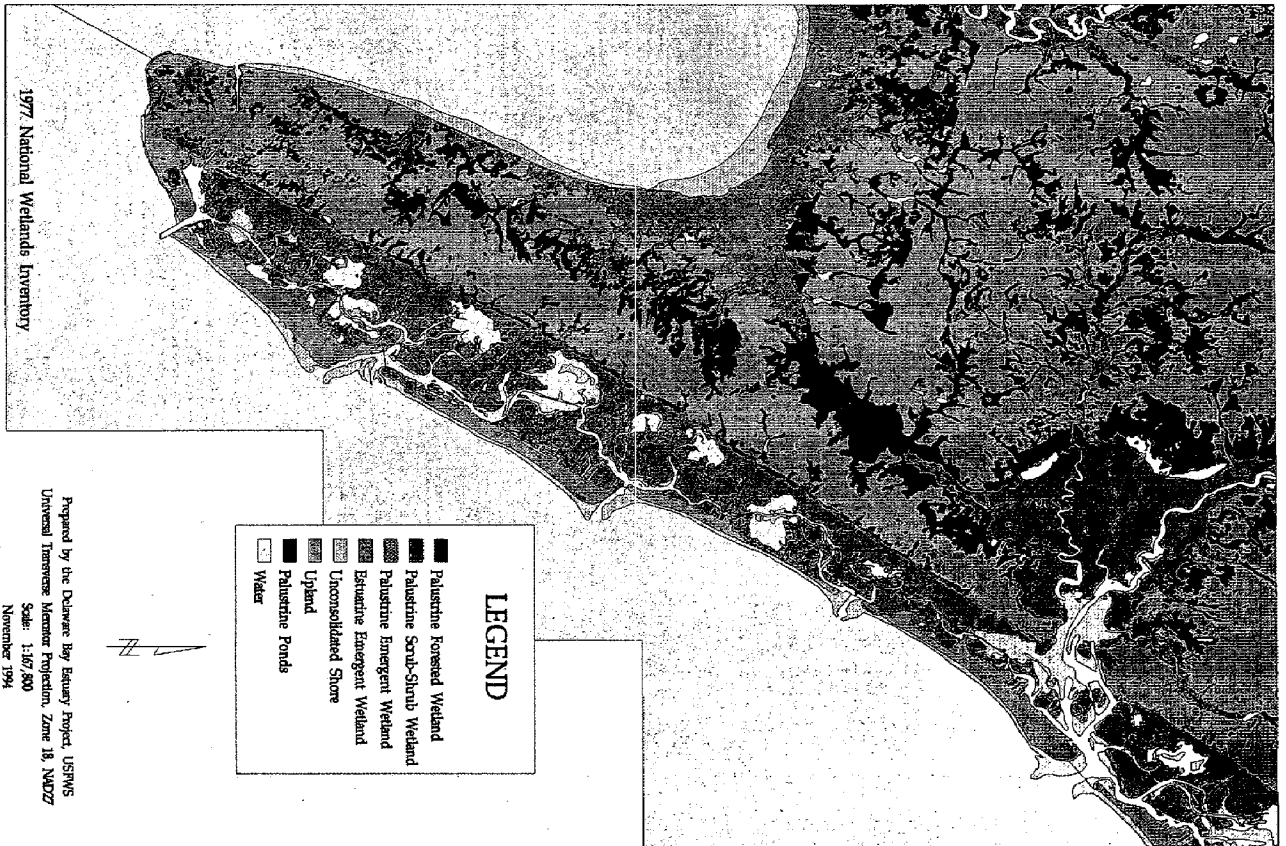


Figure 43. Cape May County Wetlands Map shows the wetlands as of 1977, for Cape May County and vicinity, along with graphs depicting trends for several categories, based on the report, "Status and Trends of Wetlands in Cape May County, New Jersey and Vicinity (1977 to 1991)", July 1993. Wetlands data are from USFWS's National Wetland Inventory.

efforts must be developed to complement the regulatory programs (See Action H4).

UPLANDS

As noted in the State of the Estuary, Chapter II, development pressures are intense within the Estuary and may accelerate as increasing numbers of people make demands on the remaining habitats. Regulation of upland development is generally under the purview of local governments and is not controlled by federal or state regulation the way wetlands are. As a result, there is little regional regulatory perspective for land use in these areas. Because of this lack of regional perspective and the fact that they are desirable for development, upland habitats, particularly forested areas and successional meadows, are being fragmented (See Figure 44). Populations of species dependent on unfragmented uplands, such as interior forest dwelling birds and certain large mammals, have declined. Future development must take place in a fashion that will not further fragment habitat; otherwise there will be a continued decrease in the populations of many species in the watershed and possibly the number of species (See Action L1).

NONPOINT SOURCE DEGRADATION

While habitat degradation from nonpoint source pollution in the Delaware Estuary is an issue and is being addressed to a limited extent by Section 319 of the Clean Water Act and Section 6217 of the Coastal Zone Management Act, the magnitude of the problem needs a more rigorous quantitative assessment. Additional resources are needed to reduce nonpoint source pollution from existing areas and to minimize the creation of new sources (See Actions in Chapter III).

SPECIES MANAGEMENT PLANS

Populations of many harvestable species, and species that are sensitive to disturbance by humans, are declining in the Delaware Estuary (See State of the Estuary, Chapter II). Many of these living resources move freely across state boundaries; thus proper management in one jurisdiction can be made more effective by coordinating management with other jurisdictions. Individual state mandated management plans must be evaluated Estuary-wide and coordinated whenever possible. Even though basin states are now required to comply with existing Atlantic States Marine Fisheries Commission interstate fisheries management plans as a result of



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Large-Tract Forest Restoration Opportunities for Area-Sensitive Forest Nesting Birds

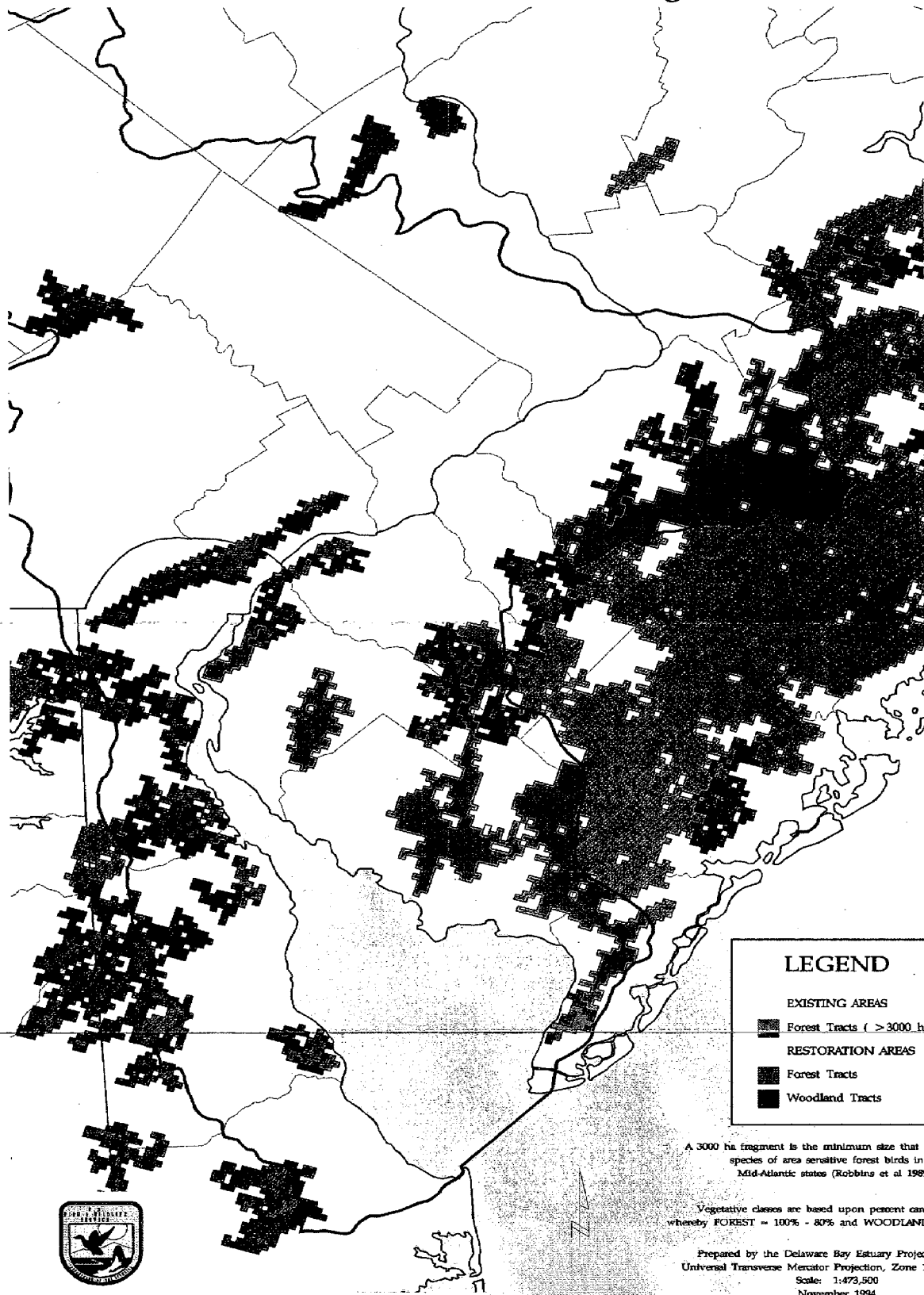


Figure 44. Forested Tract Preservation and Restoration Opportunities Map illustrates the potential for integrating living resource needs into regional planning and decision support. The map portrays opportunities for protecting and restoring large forested tracts suitable for maintaining breeding populations of neotropical migratory passerine birds, based upon U.S. Forest Service's Advanced Very High Resolution Radiometer (AVHRR) satellite data and minimum area requirements as described in "Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States," Robbins, et al., 1989. Better vegetative cover data and field checking are necessary before this map can be used in support of land use decision making.

the Atlantic Coastal Fishery Management Cooperative Act of 1993, problems with compliance still exist (See Action H1).

A mechanism needs to be established to ensure the compatibility of appropriate species management plans, strategies, and regulations among the three states and federal agencies that have responsibility for habitat in the watershed. Watershed-wide coordination and compatibility of resource management are essential for the long-term. Specific actions that need to be addressed in these plans are allocation of consumptive use (harvest), habitat protection/enhancement, and human use conflict (i.e., human disturbance of shorebirds). Plant management plans should be coordinated with animal management plans. In addition, it is important that any differences in implementation between compatible state plans be explained to the public so that there is not a sense of inequality (See Action H1).

For some species, Estuary-wide plans are not necessary because the species do not travel great distances within the Estuary and are dependent, primarily, on local habitats and management practices. Included in this group are such species and groups as terrestrial reptiles and amphibians and non-migratory gamefish and game animals.

C. Actions to Date

The Habitat Task Force of the Delaware Estuary Program is working towards completing the three actions for habitat identified in the Preliminary Conservation and Management Plan (October 1992), as the highest priority. These actions are:

- 1) Identify and publish a consensus list of important species within the Delaware Estuary, including harvestable species, endangered and threatened species, migratory species, indicator species, and ecologically important species;
- 2) Identify and publish a reference document on habitat requirements for priority species. (This will provide information on the life history of these species, what their habitat requirements are, and what local land use planners can consider to minimize impacts on these species. While this document does not specify what land use planners should do, it does provide scientific information targeted towards this user group); and



- 3) Provide user-friendly maps and interpretive tools to targeted user groups. Maps identify where appropriate habitats exist for priority species based on available information.

The first of these tasks, identifying the key species, was accomplished through a series of workshops involving many experts from within the watershed. The final list of approximately 100 species and assemblages can be found in Appendix E and is the subject of the Habitat Requirements reference document that is expected to be available in mid-1995. The list should be considered dynamic and will likely be modified and updated as more information is gathered and as our understanding of the interactions of the components of the ecosystem grows.

The third task, the production of the significant habitat maps, is currently underway and will be available in mid-1995. Actions L10, L11, and L14 discuss technical assistance for municipalities to assist them in using these tools.

D. Habitat and Living Resources Objectives

Of the fourteen objectives adopted by the Delaware Estuary Program as cited in the Introduction, six are directly related to habitat and living resources. These six objectives have been used to guide development of the actions listed in this chapter along two major themes:



To restore and maintain healthy populations of finfishes, invertebrates, birds, amphibians, reptiles, and mammals; and



To restore and maintain acreage and quality of the habitats that contribute to the ecological diversity, productivity, and aesthetic appeal of the region.

The Habitat Task Force used these objectives to develop a set of actions that, in the long run, could attain such goals as: achieving an average annual spawning population of 750,000 adult American shad in the Delaware River and its tributaries or restoring wetlands to levels commonly found in the 1920s, prior to parallel grid ditching and large scale draining.

STRATEGY FOR HABITAT PROTECTION

The Delaware Estuary Program will provide coordination among the states, federal government, private organizations, business, and industry, to protect, enhance, and manage habitat and the natural resources that rely on them. Nine actions will address the following key areas identified in this chapter and the State of the Estuary (Chapter II):



Coordination and integration of species management plans to ensure more comprehensive conservation (H1 and H2);



Identification, restoration, and protection of specific habitat areas or types (H3 and H5);



Enhancement of planning initiatives for exotic species, sea level rise, and oil spills (H6, H7, H8); and



Enhancement of scope and enforcement of regulatory programs for wetlands and priority species (H4 and H9).



Recommendations

ACTION H1: Assure Compliance with Existing Interstate Species Management Plans and Prepare Plans for Additional Appropriate Species

Why: Many living resources freely move across jurisdictional boundaries and would thus benefit from coordinated Estuary-wide management plans. A further discussion of why this is important is presented in the analysis of regulatory programs earlier in this chapter. This action describes what can be done to achieve more effective resource management utilizing existing regulatory programs.

Measure of Success: Compliance with existing interstate species management plans (top priority should be on resolving compliance issues with weakfish and bluefish plans). Development of management plans for the priority species listed in Action H1.2. Completion of management plans currently under development.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H1: Interstate Species Management			
H1.1: Existing Mandated Interstate Species Management Plans	<i>Lead:</i> Delaware Estuary Council <i>Partners:</i> States, NMFS, Mid Atlantic Fishery Management Council, Atlantic States Marine Fisheries Commission, DE River Basin Fish & Wildlife Management Cooperative	Plans for 3 fish species expected to be complete in 1995	\$75,000 per species
H1.2: Species for which Interstate Management Plans or more Enforcement of Existing Plans Needed	<i>Lead:</i> Delaware River Basin Fish & Wildlife Management Cooperative <i>Partners:</i> Atlantic States Marine Fisheries Commission, Mid-Atlantic Fishery Management Council, state management agencies, USFWS, NMFS	1995 for high priority species	\$75,000 per species

Action H1.1: Complete all Developing or Pending Mandated Interstate Species Management Plans and Assure Compliance with all New and Existing Plans

What and How: Species in the Delaware Estuary for which interstate management plans are mandated and already exist include: striped bass, weakfish, bluefish, American shad, river herring, Atlantic sturgeon, summer flounder, winter flounder, spot, croaker, red drum, Spanish mackerel, Atlantic mackerel, butterfish, Loligo squid, surfclams, sharks, snow goose, and black duck. Additional plans, including recovery plans, are in place for several threatened and endangered species and waterfowl. Plans are currently under development for tautog, scup, and sea bass and will be completed under the Atlantic States Marine Fisheries Commission (ASMFC).

The effectiveness of these plans needs to be assessed from a regional perspective. Even though basin states are now required to comply with existing ASMFC interstate management plans for fishery resources or face a federally imposed moratorium, there are still problems with compliance for certain species such as weakfish, Atlantic sturgeon, and bluefish. The Delaware Estuary Council should promote compliance with, and compatibility and coordination of, these plans by having Council representatives from the states mandate compliance within their own agencies and by pressuring other states to do so.

In addition, the "habitat" sections of these species management plans have typically not received enough attention in their preparation and utilization, especially the land use aspects.

For inshore fishery plans, the Atlantic Coastal Fishery Management Cooperative Act of 1993 should provide the mechanism to facilitate this coordination. Basin states are now required to comply with existing ASMFC interstate management plans or face a federally imposed moratorium. Other participants include the National Marine Fisheries Service (NMFS). For offshore species not covered by this Act, the Mid-Atlantic Fishery Management Council should take the lead role.

Action H1.2: Develop Memoranda of Understanding with the States and other Appropriate Parties to Develop Estuary-wide Management Plans for Selected Species

What and How: Many species that would benefit from an Estuary-wide plan are not currently addressed. These include plans that are mandated by legislation as well as those that are not. Blue crab, white perch, catfish, American eel, eastern oyster, Atlantic horseshoe crab, waterfowl, rails, breeding raptors (e.g., bald eagle, osprey, Northern harrier, peregrine falcon, marsh raptors), breeding and migratory neotropical migrants, woodcock, marine mammals, and marine turtles would be ideal choices for future plans because these species readily move across state jurisdictional borders and are affected by the sometimes varying management practices of the areas they utilize. Top priorities for 1995 are: white perch; horseshoe crabs; breeding and migrating



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neotropical migrants (songbirds that migrate between North America and tropical areas of Central and South America); and shorebirds. White perch are a priority because of their importance to both commercial and recreational fisheries. The other three species were selected because of the international importance of the Delaware Estuary area to them.

HABITAT AND LIVING RESOURCES

ACTION H2: Establish a Procedure for Enhancing Compatibility among Species Management Plans

Why: While many management plans protect or enhance habitat and call for special management practices designed to manage populations of the target species, these plans can work to the detriment of non-target species (See State of the Estuary, Chapter II). The objective of this action is to establish a procedure for minimizing conflict among management plans and to promote biodiversity and productivity.

Measure of Success: Identification or establishment of an advisory committee within one year which is empowered to review compatibility of management plans and make recommendations for change. Establishment by advisory committee of priority plans in need of conflict resolution. One workshop conducted per year. Resolution of conflicts by committee.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H2: Compatible Species Management Plans			
H2.1 Identification of Advisory Committee	<i>Lead:</i> Delaware Estuary Council <i>Partners:</i> Additional state and federal resource agencies not on Council	Short-term	\$12,500
H2.2 Estuary-wide Priorities and Strategies to Address Conflicts	<i>Lead:</i> Advisory Committee <i>Partners:</i> State resource agencies, USFWS, universities, Audubon Society, TNC, NJ Conservation Foundation, Wetlands for the Americas, Partners in Flight, DE Nature Society, Sierra Club, Natural Lands Trust, Ducks Unlimited, Izaak Walton League, and others as appropriate For fishery related issues: ASMFC, MAFMC, DRBFWMC, NMFS, and state resource agencies would be involved	Mid-term	\$100,000



Action H2.1: Identify or Establish an Interstate Species Management Plan Advisory Committee

What and How: An interstate advisory committee should be set up to identify and implement Estuary-wide priorities and strategies for addressing conflicts identified for interstate management plans. This committee would function by bringing together the state and federal resource agencies responsible for developing management plans, along with outside experts as needed, to evaluate what needs to be done and how to do it. The Delaware River Basin Fish and Wildlife Management Cooperative has traditionally functioned in this role for fishery issues. If its role cannot be expanded to include non-fishery species, a new interstate advisory committee should be established with representatives from agencies with statutory authority.

Action H2.2: Identify and Prioritize Species Management Plans that are Potentially in Conflict and Develop More Compatible Protection and Restoration Strategies

What and How: Workshops should be conducted to disseminate information and develop protection/restoration strategies that address the needs of multiple species that have conflicting interstate management plans; the Delaware Bay Shorebird Project approach should be considered a model. As part of this process, Estuary-wide objectives for species management plans would be identified as well as differences in those objectives. Examples of objectives could be: managing acreage of land as a certain habitat type; identifying and maintaining target population levels; and temporal habitat manipulations (controlling water levels, etc.)

Groups of species for which management plans have the potential to conflict with each other include: 1) shorebirds, waterfowl, mosquito control, and horseshoe crabs; 2) passerines, turkeys, and forest management; 3) migratory woodcocks, migratory passerines, and migratory raptors; and 4) open-water fisheries.

An example of how conflicts can be reduced involves the shorebird, waterfowl, mosquito, and horseshoe crab group. Changes can be made in mosquito control methods, the timing of impoundment water level manipulation, and vegetation density to benefit shorebirds without major adverse impacts on the other species. Restrictions have been placed on the timing of horseshoe crab harvest in New Jersey to reduce the disturbance to shorebirds. Snow goose grazing can also be manipulated in some cases to avoid severe depletion of vegetation from large areas. Such feeding replaces the vegetation with mudflats which is good for shorebirds, but causes erosion of the marsh.

HABITAT AND LIVING RESOURCES

ACTION H3: *Develop a Natural Community Classification System to Assist in the Protection of these Communities*

Why: Currently, biodiversity protection is focused mainly on the protection of individual species through state and federal endangered species programs and species management plans. While this is an important approach, there are many vertebrates, invertebrates, fungi, and microbial organisms which play a critical role in the functioning of the ecosystem that are not directly protected by these programs.

A major step in sustaining this intricate ecosystem is to describe its components. To accomplish this complex task, the landscape needs to be classified, or grouped, into similar assemblages of interacting plant and animal populations known as natural communities. Protection of the best examples of natural communities works toward the conservation of ecological processes and the biotic interactions which are critical to sustaining biological diversity. Classification provides a common language which facilitates setting priorities, study, and management. Each of the three state Natural Heritage Programs has completed a preliminary description of the landscape into broad categories.

However, it is currently difficult to assess the status of natural communities across the Delaware Estuary because independent state efforts are not adequately coordinated for the development of collective definitions, names, analysis, and data for refining and mapping the classification.

Measure of Success: Development of compatible classification descriptions and rankings within one year that are based on extensive field inventory and analysis. Completed community maps within five years. Adoption of classification system by environmental scientists and planners and use of the system to prepare environmental reviews, impact statements, and in monitoring plans.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H3: Natural Community Classification System			
H3.1: Classification Descriptions	<i>Leads:</i> State Natural Heritage Programs and Endangered and Non-game Species Programs <i>Partners:</i> National Biological Survey, USFWS, The Nature Conservancy, USEPA, other federal agencies, other state resource agencies	Mid-term	\$500,000
H3.2: Mapping of Community Elements		Mid-term	\$475,000
H3.3: Status and Ranking of Communities		Short-term	\$192,000



Action H3.1 Prepare Classification Descriptions for the Delaware Estuary Natural Communities

What and How: Building on the recently completed classification hierarchy of natural communities developed for the Delaware Estuary Program and contained in the Habitat Requirements Document, this action would develop standards for data collection and conduct field inventories and quantitative analyses to refine the existing state descriptions of natural communities and rankings.

Each state Natural Heritage Program has prepared a preliminary classification of natural communities. The classification considers such factors as soil character, topography, vegetation composition, assemblages of animals or other organisms, and other abiotic factors to define a natural community. The Estuary Program recently funded a project to cross-reference the state descriptions. Further refinement of this classification is required to standardize definitions and descriptions.

This classification is consistent with the hierarchical system The Nature Conservancy, in conjunction with Natural Heritage Programs, is developing for the entire U.S. That effort is also being cross-referenced nationally with other major classification systems (e.g., Cowardin, SAF Cover types, etc.). By adopting the classification hierarchy and data management standards, the Estuary Program would be able to evaluate the importance of its natural communities in comparison with those found regionally, nationally, and internationally.

Action H3.2: Map the Natural Community Elements of the Delaware Estuary

What and How: This action provides for development of a series of maps which delineate the natural communities in the Delaware Estuary. The maps would refine the broad categories currently being mapped by the USFWS GAP program. While the GAP mapping will provide broad outlines of the natural communities, this information will not be detailed enough to assess the importance of a given area or be suitable for detailed analysis, such as land use planning, environmental review, or establishing priorities (See Monitoring Plan, Chapter VIII).

Additional mapping efforts presently underway in the states, such as New Jersey's Freshwater Wetlands Mapping and Land Use/Land Cover, Delaware's Freshwater Wetlands Mapping, and others, are important mapping efforts that may provide significant data and could save time and money in completing this task.

Once the classification system has been developed, an aerial photo series that covers the Estuary study area should be identified and evaluated. For those that would support the detailed mapping required in this task, photo interpretation keys would be developed that could be used with the appropriate photography to identify the natural communities defined by the classification system. The interpretation keys would be verified through ground truthing. Once verified, the natural community types could be delineated for the study area.

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Action H3.3: Determine the Status and Rank of the Natural Communities of the Delaware Estuary and Provide Information to Assist in the Use of the Classification and Maps for Decision-making

What and How: Once the natural communities are classified and mapped, the information would provide decision-makers with a standard set of terms and concepts for describing the landscape. It also would provide discrete units which can be mapped to assist in land use and management planning for public or private land. The classification could be used to identify ecological communities for environmental reviews and impact statements. The classification could also be used to monitor trends in natural community loss and environmental change.

Through the use of the state Natural Heritage Program ranking system, this action would determine the rarity and quality of the natural communities in the Delaware Estuary. This information would be provided to decision-makers for use in establishing protection strategies and management plans.

A catalog would be prepared which contains a description of the Delaware Estuary natural communities, the maps, the classification system and protocols, and the rankings for use by public and private planners and environmental consultants.

ACTION H4: *Coordinate and Enhance Wetlands Management within the Estuary*

Why: As discussed in the analysis of regulatory programs earlier in this chapter, wetlands would be better protected if the various state and federal programs designed to protect them were more compatible with each other and comprehensive overall. This action lays out what needs to be done to achieve better regulatory protection of these wetlands.

Measure of Success: Establishment of Estuary-wide and state wetlands management plans. Coordination of enforcement programs. Increased flexibility of mitigation banks. Creation of upland buffer zones around wetlands. Restoration and creation of emergent and tidal wetlands.



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ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H4: Wetlands Management			
H4.1: Estuary Wetlands Management Plan	<i>Lead:</i> USEPA <i>Partners:</i> USACE regulatory program, USFWS, NMFS, state wetland agencies	Mid-term	Undetermined
H4.2: State Wetlands Management Plans	<i>Lead:</i> State wetland resource agencies <i>Partners:</i> USEPA, NOAA	Mid-term	\$150,000; possible grants from USEPA or NOAA Wetlands & Nonpoint Source Programs
H4.3: Coordinated Enforcement Program	<i>Lead:</i> USEPA <i>Partners:</i> USACE, USFWS, state wetland programs	Mid-term	Undetermined
H4.4: Reduction of Loss of Non-tidal Wetlands	<i>Lead:</i> DNREC <i>Partners:</i> USEPA, USACE, USFWS for general permits	Mid-term	Undetermined
H4.5: Upland Buffer Zones	<i>Lead:</i> State wetland agencies	Mid-term	Undetermined
H4.6: Mitigation Banks	<i>Lead:</i> USEPA <i>Partners:</i> USACE, USFWS, NMFS, state wetland programs	Mid-term	Undetermined
H4.7: Other Viable Restoration Concepts	<i>Lead:</i> USEPA <i>Partners:</i> USACE, USFWS, Soil Conservation Service, state wetland programs	Mid-term	Undetermined
H4.8: State Administration of Section 404 Program	<i>Lead:</i> USEPA <i>Partners:</i> USACE, USFWS, state wetland programs	Long-term	Undetermined

Action H4.1: Develop a Broad Wetlands Management Plan for the Estuary

What and How: This action proposes development of a broad wetlands management plan, that sets defined goals and objectives for wetlands protection within the Delaware Estuary, and which is responsive to the variations in federal and state wetland protection programs in the region. The plan should develop both regulatory and nonregulatory objectives for meeting established goals. This broad management plan may include a prescription for identifying priority wetland systems or potential

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wetland enhancement opportunities in the Estuary, as well as a number of regulatory and non-regulatory actions that may be available or developed for addressing these areas. Regulatory options may include categorical denial of permits in identified critical areas; elimination of Nationwide permits in critical areas; targeting of wetland restoration or enhancement projects through enforcement related Supplemental Environmental Projects (SEPs) or as mitigation for permits issued in other noncritical wetlands within the Estuary; or other actions as developed in the plan.

Procedures for determining suitable wetlands compensation projects to address unavoidable wetlands losses must be able to accommodate a wide range of compensation options, from in-kind, on-site to out-of-kind, off-site projects. Such flexibility in determining appropriate types of compensation, exercised on a case by case basis, would maximize cost effectiveness and best address statewide or regional wetlands needs. Boundary conditions to help determine what types of compensation to undertake could be part of state comprehensive wetlands management plans (Action H4.2).

Non-regulatory options may include the development of quarterly project coordination meetings, for wetland projects within the Estuary, that would be attended by representatives of the various state and federal agencies to address consistency questions; public awareness and education activities; and outreach activities with local governments and/or developers that may facilitate a planning process to avoid the use of critical wetland areas and/or that reverses fragmentation of habitat corridors.

Action H4.2: Develop State Comprehensive Wetlands Management Plans that are Compatible with and Complement the Broad Plan (Action H4.1)

What and How: The USEPA National Wetlands Policy Forum provided recommendations for the states for developing comprehensive wetlands plans. In 1994, the State of Delaware completed a comprehensive conservation and management plan for tidal wetlands that meets the intent of those recommendations. While there are no enforceable aspects of the plan, it can be used as guidance to structure state policy and create enforceable acts. While the State of Delaware has made several attempts to develop a freshwater wetlands management program, it currently does not have one. Action H4 lays out options that the state does have for freshwater wetlands protection until a full program is developed. The State of New Jersey is expected to complete a plan in the Spring of 1995 that will take into account both its tidal and non-tidal programs. The State of Pennsylvania should apply for grants from NOAA or USEPA to complete a comprehensive plan.

Action H4.3: Enhance the Effectiveness of Existing Permit Programs through a Coordinated Enforcement Program

What and How: This action would enhance the effectiveness of existing permit programs in the Estuary through a coordinated enforcement program that targets



sensitive areas and promotes the use of SEPs. Workloads could be distributed among the various interests through the use of Interagency Agreements and field level Memoranda of Understanding.

Action H4.4: Reduce Loss of Non-tidal Wetlands in Critical Areas Less than or Equal to One Acre

What and How: This action would reduce loss of non-tidal wetlands in critical areas less than or equal to one acre by not issuing water quality certifications for Nationwide Permit 26, by requiring predischage notification and discretionary authority for all such projects within the Estuary, or through the development of Regional General Permits that address specific areas of concern.

These methods to reduce wetland loss are currently available and could be implemented without a new wetland program. Pennsylvania and New Jersey have utilized the approach of not approving water quality certification for Nationwide Permit 26. Clean Water Act Section 401 water quality certifications need to be reissued every five years. If a blanket certification for Nationwide Permit 26 is not issued or waived by Delaware during the next renewal process in 1995, an individual water quality certification would need to be acquired, which would increase the workload of the state. As an alternative, a Regional General Permit could be developed by the Philadelphia District USACE for the Estuary to address certain state level concerns or that might exclude or condition certain projects from blanket authorization.

Action H4.5: Create Upland Buffer Zones Adjacent to Tidal and Non-tidal Wetlands

What and How: This action would create upland buffer zones adjacent to tidal and non-tidal wetlands within the Estuary, using New Jersey's model. Such buffer areas could be incorporated as part of a mitigation policy for issued permits. These buffers could also be mandated via state riparian laws for the purpose of creating floodways. Consideration would need to be given to the spacial pattern of relative sea level rise when determining where buffers should occur (See Action H7).

Action H4.6: Develop Potential Sites in Strategic Locations for the Development of Mitigation Banks

What and How: Mitigation banking is the restoration, creation, or enhancement of wetlands and other aquatic habitats expressly for the purpose of providing compensatory mitigation in advance of discharges into wetlands permitted under the Section 404 regulatory program. This technique can be successfully used to compensate for the loss of wetlands when no less damaging upland alternative exists for the project. However, banks must be located in both tidal and non-tidal areas and have designs that incorporate multiple wetland functions to ensure that proper credits are being considered in the accounting system. This action supports the establishment of such banks when appropriate. Sites in the mitigation bank could be

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used to accommodate wetlands compensation projects ranging from in-kind, on-site to out-of-kind, off-site projects.

Action H4.7: Explore other Viable Mitigation/Wetland Restoration Concepts to Increase Wetland Acreage in the Estuary

What and How: This action supports agricultural buffer strips and reconvertng farmed wetlands as an effective and inexpensive mitigation alternative. Reconvertng farmed wetlands may be an important mitigation tool to explore in light of the recent Dolan Supreme Court decision. The Dolan decision requires application of the new "rough proportionality" test for compensation. Agricultural reconversions are generally much easier and less costly than many other wetland creation options. Therefore, reconversions will be easier to quantify as roughly proportional in terms of dollar and environmental value cost/benefit proportionalities. It should be noted that the new burden for quantifying these proportionalities now rests with the government rather than the permittee. The agricultural reversion approach could make the workload on the government more manageable.

Action H4.8: Encourage States to Administer the Federal Wetland Permit Program in Non-tidal Areas (Section 404 of the Clean Water Act).

What and How: The State of New Jersey has formally assumed responsibility for the administration of the federal wetland permit program under Section 404 of the Clean Water Act. Although USEPA still has oversight over New Jersey on this issue, the state has more direct control over how its wetlands are managed.

The States of Delaware and Pennsylvania should be encouraged to administer this program in the non-tidal areas of their states, provided that 1) legislation is in place that is at least as stringent as the enforcement (Section 309) and permitting (Section 404) provisions of the Clean Water Act and 2) adequate personnel and financial resources can be allocated to administer the program. Delaware has expressed interest in the program and has attempted to pass a freshwater wetlands law on several occasions. Continued efforts should be undertaken to assist Delaware with the development of a freshwater wetlands law that is sufficient to permit state assumption. Similar discussions with Pennsylvania officials regarding administration of the Section 404 program should also be initiated.

ACTION H5: Target Habitat Enhancement Opportunities for Present and Future Action
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Why: While long-term planning for habitat enhancement opportunities is essential, many actions that could be taken right now are perhaps not receiving as much attention as they should and are, therefore, not being accomplished as quickly as may be possible.



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The following actions relate to specific sites that would benefit from additional restoration funding and agency focus. H5.1 through H5.3 are specific to wetland enhancement while H5.4 through H5.8 provide for other enhancement opportunities.

Measure of Success: See individual sub-actions.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H5: Habitat enhancement opportunities			
H5.1: <i>Phragmites</i> Reduction in Tidal Wetlands	<i>Leads:</i> DNREC/DE DFW, NJ DEP/DFGW, PA Game/Fish Commissions, PADER <i>Partners:</i> USFWS - NWR Lands	Mid-term	\$150,000 per year
H5.2: Salt Marsh Mosquito Control	<i>Lead:</i> Mosquito control commissions <i>Partners:</i> State resource agencies	Long-term	\$1 million per year
H5.3: Restoration of Tidal Wetland Impoundments	<i>Lead:</i> State wetlands programs <i>Partners:</i> USEPA	Short-term	Costs are site specific
H5.4: Artificial Reefs	<i>Lead:</i> DNREC <i>Partners:</i> NJDEP, USACE	Short-term	\$200,000 per year
H5.5: Shorebird Viewing Areas and Warden Programs	<i>Lead:</i> NJDEP, DNREC	Short-term	\$25,000 per year for staff; \$20,000 for kiosks & viewing platforms
H5.6: Sand Mining Sites	<i>Leads:</i> Non-profit conservation groups, USFWS (Partners in Wildlife)	Mid-term	Costs are site specific
H5.7: Fish Passage Restoration	<i>Lead:</i> Delaware Basin Fish & Wildlife Management Cooperative <i>Partners:</i> State and federal regulatory agencies, entities that own or are responsible for individual dams	To be determined based on individual projects	Costs are site specific; range from \$10,000 to \$1 million
H5.8: Oyster Reef Enhancement	<i>Lead:</i> NJ Bureau of Shellfish	Mid-term	\$1500 per acre; 100-1600 acres per reef, depending on condition of reef

Action H5.1: Reduce *Phragmites* Cover in Tidal Wetlands

What and How: A newly proposed initiative that would benefit from Delaware Estuary Council support is the reduction of *Phragmites* cover in tidal wetlands by 40 percent within the next 10 years, permitting revegetation by Pre-*Phragmite* emergent vegetation (See State of the Estuary, Chapter II, for further discussion of *Phragmites*; Figure 42 shows the extent of *Phragmites* in the State of Delaware). This action would use best available management techniques (e.g., two year herbicide/burn treatment or water level management) to achieve the reduction goal. In Delaware, the existing cost-share program might be modified as follows: treat 2000 acres per year; increase state funds from \$40,000 to \$150,000 per year; and increase state to private cost-share ratio from 50:50 to 75:25 to encourage more private landowner participation. While both New Jersey and Pennsylvania are putting some effort in controlling *Phragmites*, a similar aggressive approach should be adopted Estuary-wide. Mitigation funds could be used to support such activities.

Measure of Success: Forty percent reduction in *Phragmites* cover in tidal wetlands within the next 10 years, permitting revegetation by pre-*Phragmites* emergent vegetation.

Action H5.2: Encourage Environmentally Compatible Methods for Salt Marsh Mosquito Control

What and How: This action would be accomplished by using OMWM (Open Marsh Water Management) to reduce use of chemical insecticides and to restore surface water (e.g., ponds, pannes) in parallel-grid-ditched marshes.

Where OMWM is not permitted, or cannot be done, the most environmentally-safe but still effective insecticides would be used to achieve mosquito control where needed; sufficient funds should be provided to purchase the most desirable products.

Measure of Success: Ninety-five percent reduction in tidal wetlands acreage that need to be sprayed within 25 years. In the State of Delaware, 6000 acres of wetlands that function as mosquito breeding habitat managed under Open Water Marsh Management.

Action H5.3: Restore and Enhance Poorly Functioning Tidal Wetland Impoundments

What and How: Some tidal impoundments have become all open water/mudflat habitat, having lost most of their emergent vegetation due to poor tidal exchanges and salt accumulations. Other impoundments have been kept excessively dry, leading to conversions from cordgrass wetlands to *Phragmites* dominated wetlands.

Diverse emergent vegetation/shallow pool interspersed habitats should be restored to enhance the fish and wildlife habitat values of such impoundments. This can be done



using flexible water control structures managed under dynamic, multiple-objective water management plans. Note: Impounded salt hay meadows, while having restricted tidal exchanges and altered conditions, are not necessarily non-functioning units, since they still retain extensive vegetative cover and serve as valuable habitats for several species. While restoration of frequent tidal exchanges to some of these salt hay meadows can cause desirable conversions of these areas benefitting many fish and waterbird species, there will be losses of habitat critical to other species. These losses must be considered in terms of a regional restoration strategy.

Measure of Success: Restoration of 10,000 acres of tidal wetland impoundments within 10 years.

Action H5.4: Develop Artificial Reefs to Refocus Biological Production in the Delaware Bay

What and How: While artificial reefs do not create biological production, they do channel the primary production into different, and perhaps more valuable, communities.

The State of Delaware is currently preparing a plan for the development of a system of eight artificial reefs in Delaware Bay. These reefs would be low-profile (maximum of 5 foot relief) and would be situated where there would be minimal hazard to navigation. Current plans are to utilize materials such as concrete culverts as opposed to derelict ships. New Jersey is concentrating its reef building efforts in the Atlantic Ocean.

The Atlantic States Marine Fisheries Commission has an Artificial Reef Committee that is developing guidance on the proper use of artificial reefs for fishing or fishery habitat enhancement. This guidance is generally consistent with NOAA's National Artificial Reef Plan of 1984.

Measure of Success: Implementation of artificial reef development based on State of Delaware plan within two years.

Action H5.5: Enhance Shorebird Warden Programs to Patrol Beaches and Reduce Conflicts Between Human Use and Shorebird Feeding and Resting Areas

What and How: North America's second largest concentration of migratory shorebirds utilizes Delaware Bay beaches for feeding and resting areas in the spring. Human disturbance of these areas during the month of May can prevent the shorebirds from acquiring sufficient food to successfully complete their migration and breeding. The critical stopover time is May 1 through June 15.

Current efforts at reducing disturbance to shorebirds in New Jersey have not been totally successful. Expansion of this program is needed to protect shorebirds at all

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major beaches. In addition, access to many of the prime nesting areas is through private land, and the cooperation of landowners and the community is needed in order for the program to be successful.

The system of viewing platforms should be extended to all major shorebird feeding areas to provide comfortable, accessible bird watching while preventing disturbance to birds. These platforms would function to keep people from wandering on the beach and would be the focal point for educational materials.

The shorebird warden/educator program should be extended to provide interpretive assistance at major viewing areas. Color educational signs should augment each site during the migration.

Measure of Success: Creation of 20 informational kiosks at shorebird viewing areas (10 each in New Jersey and Delaware) and 20 viewing platforms within five years.

Action H5.6: Restore Sand Mining Sites

What and How: There are numerous sand mining sites in New Jersey that have essentially converted upland areas into openwater lakes with steep sides. These lakes could be greatly enhanced as habitat if shallow vegetated areas were created along the edges. Most of the sites are privately owned, and any restoration efforts would need to be cooperative ventures with the landowner.

Programs such as the USFWS Partners for Wildlife could work with landowners to provide funding and technical support.

Measure of Success: Successful restoration of shallow water habitat in one sand mining site every two years.

Action H5.7: Restore Fish Passages

What and How: According to the Delaware River Basin Fish and Wildlife Management Cooperative (DRBFWMC), access to 16 streams in the Delaware Basin, that were historically used by American shad for spawning, are impeded by 60 dams. Production of shad, as well as other anadromous fish, such as river herring, would be greatly enhanced by providing passage facilities so that the fish can get past the dams. While each dam needs to be evaluated on a case by case basis, wherever possible, anadromous fish passage should be provided to historical spawning streams. Techniques and policies for conducting this action should be consistent with the DRBFWMC Policy. An example of the techniques would be to require fish passage consistent with established guidelines every time a dam comes up for review or relicensing. Consideration must be given to possible introduction of undesirable species and/or alterations in the aquatic food web as a result of providing fish passage (e.g., carp, gizzard shad).



The locations of the major blockages are identified in Figure 41. In 1985, the DRBFWMC selected the Schuylkill, Brandywine, and Lehigh Rivers as the priority rivers for shad restoration based on habitat quality and historic use. The Schuylkill and Brandywine are within the Delaware Estuary Program Area of Concern, while the Lehigh enters the Delaware River above Trenton at Easton, Pennsylvania. An example of a site that could greatly improve fish passage for a small investment is the Fairmont Dam on the Schuylkill River. The existing fish ladder needs to be modified by cutting a few notches in it to alter the water flow, thus making it easier for shad and herring to enter.

PSE&G has committed to mitigate five of the blockages as part of the Salem cooling tower project. Additional projects should be undertaken as funds become available and as permits come up for review.

In general, building permanent fish passageways is very expensive. While site specific estimates are not currently available, costs for individual sites could range from a few thousand dollars to millions of dollars.

Measure of Success: Restoration of anadromous fish access to historic spawning grounds in the following priority rivers: Schuylkill, Brandywine, and Lehigh.

Action H5.8: Enhance Oyster Reefs

What and How: Planting of cultch, mainly shell from processed surf clams, has proved to be an effective method of enhancing oyster reefs. This is a widely used technique that is limited only by funding.

The current problems with oyster diseases (Dermo and MSX) need to be resolved before the placement of cultch can be effective in the Lower Bay. Upper Bay beds, where MSX and Dermo are not as prevalent, would benefit from placement of cultch.

Measure of Success: Periodic enhancement of appropriate oyster reefs as identified by state resource agencies.

ACTION H6: Develop and Implement an Estuary-wide Policy for the Introduction of Exotic Species

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H6: Policy on Introduction of Exotic Species	<i>Lead:</i> Delaware Estuary Council <i>Partners:</i> State resource agencies, USCG (for ballast water issues), NMFS, USFWS	Mid-term	\$25,000

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Why: Many species that are not native to the Delaware Estuary have the potential to cause tremendous ecological and economic damage, as they have in other east coast watersheds. Some of these "exotic" species have the potential to cause ecological harm by displacing native species or changing the quality of the habitat for other species.

Some of these species, such as grass carp, hydrilla, and purple loosestrife, have already been introduced intentionally into the Delaware. Others, such as the zebra mussel, while not yet in the Estuary, have the potential of being introduced unintentionally via ballast water or other vectors. Nutria, a destructive rodent that was introduced in other regions of the country for the purpose of developing a fur industry, is currently in the Chesapeake area and could spread to the Delaware. In recent years, there have been proposals to introduce additional non-native species for commercial and recreational purposes. Examples of these species include the Japanese oyster and Pacific salmon.

What and How: This action proposes an Estuary-wide policy, to be developed through a Memorandum of Understanding, to determine when non-native organisms can be introduced and develop safeguards for unwanted, unintentional introductions prior to their taking place. A major aspect of preventing unintentional introductions would involve the proper management of ship ballast discharges in the Estuary. The policy would be fully consistent with the Non-Indigenous Species Act. Exotic species that have already established themselves in the Delaware watershed would be addressed in Actions H1 and H2.

Measure of Success: Policy developed and adhered to by all relevant parties by 1998. No unwanted exotic species introduced to the watershed.

ACTION H7: Implement Measures to Protect Shoreline and Littoral Habitats that are Threatened by Sea Level Change

Why: It is accepted in the scientific community that sea level has been rising in the Delaware Estuary. However, the rate of future rise is now subject to debate (Kraft et al., 1992). As described in the State of the Estuary, Chapter II, a gradual rise in sea level will shift habitats landward. However, if sea level rise occurs faster than new habitats can form, low lying areas within the Estuary will be inundated and lost. A rapid rise in sea level can also flood structures built in low lying areas such as houses, bridges, factories, and wastewater treatment plants.

Because of the ramifications of possible rapid sea level rise, each of the three basin states should utilize a concept of "no regrets" management, as adopted by the State of Delaware. The no regrets concept means that certain management actions should be undertaken now that will be environmentally beneficial if sea level does rise faster in the future, but would not cause an undue economic burden if it doesn't rise faster



than the present background rate. Such a concept could be incorporated into the state coastal zone management plans.

In order to make more informed decisions when planning for sea level rise, more information is needed. It would be desirable to model what will happen for two rates of sea level rise (base and a faster scenario) to begin looking at potential changes and possible strategies for dealing with sea level rise.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H7: Protection of Habitats Threatened by Sea Level Change			
H7.1: Identification of Sea Level Changes and Mitigation Strategies	<i>Leads:</i> State coastal zone management agencies <i>Partners:</i> NOAA, USACE, academic institutions, NMFS, USEPA, PSE&G	Short-term	\$150,000
H7.2: Techniques to Prevent Tidal Wetlands Losses	<i>Leads:</i> State coastal zone management and regulatory programs <i>Partners:</i> USACE, USEPA, NOAA, USFWS	Mid-term	\$50,000
H7.3: Prevention of Emergent Tidal Wetlands Loss	<i>Lead:</i> DE Fish & Wildlife <i>Partners:</i> USACE, DE Soil and Water, NJDEP	Mid-term	Costs are site specific depending on technique

Action H7.1: Identify Potential Habitat Changes Due to Sea Level Rise, Conduct Pilot Project, and Develop Mitigation Strategies

What and How: This action recommends that the state coastal zone management agencies evaluate estimates of sea level rise based on existing information and then adopt the one that they feel is the most realistic. They should also model which geographic habitats would be affected. Mitigation strategies should be developed to counter these losses. These scenarios would be revisited every five years or in light of newly published data. A pilot project should be conducted in New Jersey in cooperation with PSE&G to evaluate one site.

Planning for the rise in sea level should consider options such as property buy-outs or realigning roadways as a cost effective way to deal with flooding. These options would provide opportunities to restore or create wetlands by creating openings in roadways to facilitate free exchange of water and biota.

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Measure of Success: Adoption of most likely estimate of sea level rise by all three state coastal zone programs. Completion of pilot project to evaluate effect of varying scenarios of sea level rise on a limited geographic area. Inclusion of sea level rise planning in coastal zone management plans.

Action H7.2: Assess Regulatory Programs related to Erosion Control and Encourage Innovative Techniques to Prevent Tidal Wetlands Loss

What and How: This action recommends an assessment of each state's regulatory program for its ability to promote or require environmentally sound erosion control methods, and its effectiveness, especially in light of sea level rise scenarios. Where necessary, this action supports regulatory or statutory changes to ensure such methods are used or suitable mitigation requirements are in place. This action also recommends that appropriate regulatory agencies be receptive to techniques, other than standard engineering strategies, to prevent tidal wetland losses. These may include non-structural methods to achieve shoreline erosion control where needed (e.g., vegetation plantings instead of bulkheads). In areas of high erosion rates where vegetation plantings won't work, but erosion control is still needed to protect developed property, structures would be encouraged that contain some habitat value (e.g., rip-rap) instead of flat vertical structures such as bulkheads.

Measure of Success: Modification of regulatory programs to allow for innovative techniques in identified areas.

Action H7.3: Consider Measures to Protect Key Emergent Tidal Wetlands

What and How: As the previous actions and the Monitoring Plan (See Chapter VIII) are implemented, it may become clear that some critically important emergent tidal wetlands are being lost (via drowning and conversion to shallow bay bottoms and mudflats) faster than they are being replaced. A carefully considered decision to try and maintain these emergent tidal wetlands may be needed if we are to maintain a close approximation of the current mix, quantity, and spatial arrangement of wetland habitats necessary for the living resources of this ecosystem. At that point, the Delaware Estuary Council, Monitoring Coordinator and Advisory Committee, states, USACE, USFWS, and USEPA should work cooperatively through a committee to develop guidelines or other decision support tools for designating specific emergent tidal wetlands as "critically important". Some techniques that should be considered include:

- ⇒ Use of thin-layer disposal of excavated material over subaqueous bottoms or existing, but deteriorating, emergent tidal wetlands to build up and maintain elevations at suitable heights for their perpetuation (federal permit required).
- ⇒ Manage existing impoundments for hydroperiods suitable for the maintenance and perpetuation of emergent tidal wetlands.



- ⇒ Create upland buffer zones, where physically possible, to allow further landward transgression of emergent tidal wetlands.
- ⇒ Create newly impounded wetlands with water management capabilities to be able to maintain emergent tidal wetlands in areas that would otherwise be converted by excessive tidal inundation.

Measure of Success: Establishment of guidelines for maintaining emergent wetlands using aggressive techniques — if decision is made by the Council to try to counteract the effects of sea level rise.

ACTION H8: Facilitate Coordination among the States to Update and Improve Environmental Sensitivity Index Mapping for Hazardous Spill Response Information

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H8 : Hazardous Spill Response Information	<i>Lead:</i> Delaware Estuary Council <i>Partners:</i> USEPA, NOAA, RPI, USFWS, USCG, MSRC, DBRC, USACE, NJDEP, DNREC, PADER, Maritime Exchange of the Delaware River & Bay	Short-term; review on a periodic basis	Undetermined

Why: Periodically updated mapping of sensitive environmental areas that would be affected by oil or hazardous material spills is necessary in order to quickly and efficiently protect these areas in the event of a spill.

What and How: This mapping should be comprehensive, seasonally specific, detailed in terms of shoreline and aquatic habitat types, and should be developed in a digital format that can be updated frequently. It is very important that this mapping be consistent in scale and classification across state boundaries throughout the Delaware Estuary tidal watershed as well as along the Atlantic coastlines of New Jersey and Delaware. This will require a commitment of full participation from the three states.

Several entities are currently working to develop improved mapping and GIS coverages of seasonally sensitive habitats that can be used for oil spill response and updated on at least an annual basis. NJDEP currently has a sophisticated GIS oil spill model, developed with assistance from NOAA and Environmental Systems Research Institute (ESRI), the makers of ArcInfo GIS software. However, this model is currently lacking living resources and habitat data for Delaware and Pennsylvania. The Delaware Bay and River Cooperative (DBRC) also has an oil spill response scenario model which was

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developed by Applied Science Associates (ASA), Rhode Island. This model has no environmental data.

Due to the critical mass of entities developing digital coverages of sensitive habitats, Research Planning, Inc (RPI) and the Marine Spill Response Corporation (MSRC) are both interested in "piggy-backing" on these other efforts in order to update and improve the Environmental Sensitivity Index maps, which were originally developed by RPI. The States of Delaware (DNREC) and New Jersey (DEP) and NOAA are also interested in participating in this effort. The updated and improved ESI maps and digital data would also include more detailed shoreline mapping (e.g., type of beach, structures), and roads, marinas, boat ramps, and other information important to oil spill response.

There have already been informal meetings between NOAA, RPI, MSRC, USFWS, USEPA, USCG, NJDEP, DNREC, and PADER regarding the need for improved seasonally sensitive habitat mapping and digital data for oil spill response. NOAA has recently decided to fund the updating and digitization of Environmental Sensitivity Index maps. Starting in October, 1994, Research Planning, Inc. will carry out this task, having developed the previous set of ESI maps. All that is needed is a strong commitment from the three states to provide assistance by making existing habitat maps and data available and by reviewing draft ESI maps.

Measure of Success: Maps available for use by 1996. Updates conducted periodically.

ACTION H9: Consider Priority Species in Regulatory Reviews and Environmental Impact Statements

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION H9: Consideration of Priority Species in Regulatory Reviews	<i>Lead:</i> Delaware Estuary Council <i>Partners:</i> Agencies that perform or comment on EISs and regulatory reviews, including USEPA, USACE, NMFS, USFWS, state resource agencies	Short-term	Undetermined

Why: Many species are adversely impacted when projects destroy or degrade habitat or are carried out during times of the year when a species is most vulnerable. Most species are not considered in regulatory reviews, such as Clean Water Act Section 404 reviews, National Environmental Policy Act (NEPA) reviews, and water quality certificate reviews, or Environmental Impact Statements, unless they are listed as threatened or endangered, are being considered for such status, or are commercially



or recreationally important. A less formal consideration of the priority species for the Delaware Estuary, as developed by the Delaware Estuary Program, could prevent more species from being added to the threatened or endangered list.

What and How: Selected priority species identified by the Delaware Estuary Program should be considered in future Environmental Impact Statements and regulatory reviews. Information on the habitat requirements of these species will be available from the Delaware Estuary Program Habitat Requirements Document as well as the GIS species mapping. "Consideration" means that those individuals performing reviews would take the opportunity afforded to them to make recommendations to either avoid impacts to the priority species, or at least minimize them. It does not mean that the status of these species is elevated to the point where permits would be denied based on impacts to these species.

One agency would be designated with lead responsibility to draft a Memorandum of Understanding. The agreement would include a designation of which species to include, a process to change that list, and a process to incorporate the "consideration" into review procedures.

Measure of Success: Selection of an appropriate subset of the Delaware Estuary Program Key Species. Establishment of criteria for definition of "consideration". Agreement by responsible entities to "consider" key species in their regulatory reviews.

CHAPTER VI: Toxics Action Plan

Toxic substances in the Estuary are a problem (as described in Chapter II). Toxic substances are present in the water column, sediments, and organisms in the Estuary. The actions recommended in this chapter are intended to identify and mitigate the adverse effects of these contaminants on living resources, reduce the inputs of toxic substances to the Estuary, and improve protection of human health by improving the process by which fish consumption advisories are issued.

The Delaware Estuary Program has developed a Preliminary List of Toxic Pollutants of Concern (Table 4) to focus efforts to mitigate toxic effects in the Estuary. Actions recommended in this chapter are intended to identify and reduce these pollutants.

Toxic substances are present in the water column, sediments, and organisms in the Estuary.

A. Analysis of Existing Programs

Coordination among the three states is needed to set priorities to control pollution sources. Water quality-based toxic controls for the Estuary should be developed and regulatory and permitting authorities should be encouraged to use them.

Dischargers of toxic substances are regulated based on water quality criteria. The effectiveness of these criteria should be evaluated by monitoring exceedances of the criteria as well as any adverse effects that may be related to toxic contamination.

The New Jersey Pollutant Discharge Elimination System, Pennsylvania Clean Streams Law, and the Delaware Environmental Protection Act integrate the state permit programs for point source dischargers and the federal National Pollutant Discharge Elimination System (NPDES). DRBC leads an interstate effort to meet water quality standards in the Delaware Estuary under the Delaware River Basin Compact. Section 303(d) of the Clean Water Act of 1987 requires states to identify those waters for which existing controls are not stringent enough to meet water quality standards and develop Total Maximum Daily Loads (TMDLs) for those waters, on a priority basis. A TMDL is the daily loading of a pollutant from all sources to a water body, under specified conditions, which still assures that water quality criteria are not exceeded.



Fish contamination is addressed by various state and federal agencies. The U.S. Food and Drug Administration (FDA) is responsible for ensuring that all commercial fish and shellfish transported across state boundaries are safe for human consumption. The U.S. Fish and Wildlife Service (USFWS) is responsible for protecting those who fish in National Refuges for consumption. Individual state agencies have the primary responsibility for protecting the fishing community (both recreational and subsistence) within their states. States fulfill their responsibilities through the issuance of fish/shellfish advisories. Because advisories for the Delaware Estuary are issued separately by the three states, they are not always consistent. Public confidence in the advisories would increase, and the protection of public health would improve, if advisories were consistent for the Estuary.

The actions described in this chapter will address the issue of coordination among the state, federal, and interstate agencies responsible for protection of the Delaware Estuary based on the regulatory functions described above.

B. Recommended Strategy

The Estuary Program will provide coordination among the states, the federal government, DRBC, business and industry, and interested citizens to protect the Estuary from toxic contamination and to work to mitigate existing contamination. This will be done through actions in four areas:



A toxics management strategy has been developed which will provide a forum for exchange of information on toxic substances in the Delaware Estuary and coordinate efforts to identify, study, and mitigate these pollutants on a Estuary-wide basis.



To reduce toxic substances in the Estuary, pollution prevention and public awareness actions are recommended.



Ongoing regulatory initiatives are supported to develop TMDLs for toxic pollutants for the tidal river portion of the Estuary that will assure that the designated uses of the Estuary are achieved.



To better protect human health and the health of biota of concern, a systematic and coordinated approach to sampling, analyzing, interpreting, and communicating the results of fish and shellfish contaminant data within the Delaware Estuary is recommended.



Recommendations

TOXIC MANAGEMENT STRATEGY

ACTION T1: *Implement a Toxics Management Strategy to Assist Environmental Managers in Developing Regional Prevention and Control Strategies*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T1: Toxics Management Strategy	<i>Lead:</i> DRBC <i>Partners:</i> States, federal agencies, industry, environmental groups	Begin January, 1995; long-term activity	\$50,000

The proposed Management Strategy is designed to assist regional environmental managers and users of estuarine resources in developing appropriate prevention and control strategies based on sound technical information. Strategies are needed when a toxic substance or group of toxic substances is causing a negative impact or may potentially cause an impact on the ecosystem, or could adversely affect human health. Coordination is needed among the three states and the federal agencies responsible for managing the Estuary to better assess and mitigate adverse affects due to toxic contamination.

The strategy, described by the flow chart (Figure 45), is divided into the following components: problem observation, problem identification, source characterization, and solution development. The final strategy must be implemented Estuary-wide, and as needed on selected tributary basins, by the States of Delaware, New Jersey, and Pennsylvania, in order to resolve toxic problems.

Present regulatory strategies rely upon state water quality criteria and standards to protect designated uses and prevent additional degradation of the Estuary. While this approach is sound, the extent of available data for each toxic substance varies and site-specific factors are generally not considered. In addition, the cumulative effect of all toxic substances on the aquatic communities is unknown. Therefore the Delaware Estuary Program strategy utilizes observed or predicted exceedances of water quality criteria, or observed impairment of viability of populations and communities, to initiate the development of specific control strategies.

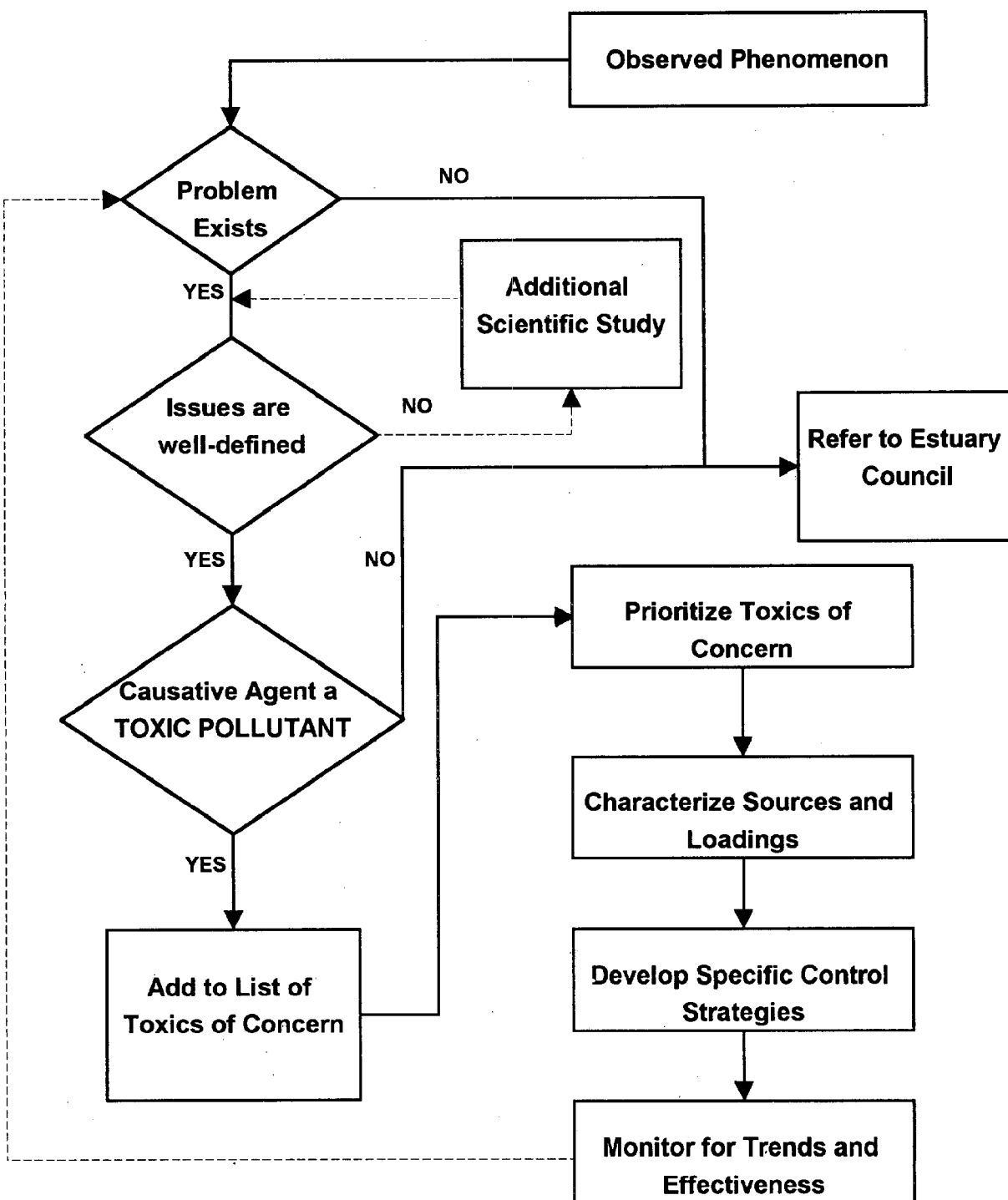


Figure 45. Toxics Management Strategy



Our understanding of estuarine processes and functions is limited, and yet damage to the Estuary may not be easily repaired once it has occurred. Therefore, it is wise to take a proactive approach, based on indicators of the health of the Estuary, to support management decisions.

The Flow Chart

The toxics management flow chart on the preceding page describes a decision-making process from problem identification to problem mitigation. Specific elements of the flow chart are described below:



Observed phenomena

An observed or predicted phenomenon can manifest itself in several ways, including but not limited to the following:

- ⇒ Impairment of ecosystem function;
- ⇒ Population or community effects;
- ⇒ The known introduction of specific chemicals of concern;
- ⇒ Exceedances of regulatory criteria or standards; or
- ⇒ Trends in specific chemicals in biota, sediment, and water.



Problem Exists/Issues are Well Defined/Causative Agent a Toxic Pollutant?

If a problem exists, a determination must be made about whether the issues are well defined, or if more study is needed. If more study is needed, sources of funding must be identified to conduct the studies. When the issues are well defined, and the weight of scientific evidence indicates that the observed phenomenon was not caused by a toxic substance, the problem will not be handled under this strategy, but must be referred to the appropriate experts. If the causative agent is a toxic substance, then this pollutant must be evaluated to determine if it should be added to the List of Toxics of Concern.



Add to List of Toxics of Concern

A Preliminary List of Toxics of Concern has been developed for the Delaware Estuary (Table 4). The criteria and assumptions used in listing these pollutants is at the back of this chapter. A List of Toxics of Concern should be identified as a major output of the Program and should be reviewed at least every two years, and revised as necessary, to reflect new information. The Toxics Task Force has added zinc and polycyclic aromatic hydrocarbons to the Preliminary List of Toxics of Concern based on new information (Costa and Sauer, 1994). New data obtained between revisions should be evaluated to determine if toxic substances should be added to, or deleted from, the list. This will lead to the final

two parts of this strategy: source characterization and solution development. It is imperative that this list be prioritized in order to best use available resources.



Characterization of Sources and Loadings

Characterization should include a list of all sources, both point and nonpoint, that could potentially discharge a given toxic substance. Given the resources available, this list should be prioritized based on an estimation of loadings from point and nonpoint sources. While point sources are easier to identify and monitor through permits, the extent of the contribution of nonpoint sources to impairment of water quality should also be evaluated.



Develop Specific Control Strategies/Monitor for Trends and Effectiveness

The next step in this process is the actual development of solutions to abate the negative impact on the environment. First, specific prevention and control strategies must be developed. For example, these might include new or modified permit limitations for point sources, Best Management Practices for nonpoint sources, remediation of hazardous waste sites, and abatement of combined sewer overflows. These strategies could be applied either basin-wide or to a specific site; the site specific approach could be used to control known or newly identified "hot spots".

Finally, the ecosystem must be monitored for trends and effectiveness. To determine the effectiveness of a prevention or control strategy, the results of the new control strategy must be monitored. Ultimately, it is this last step that will determine when the health of the ecosystem has been restored to an acceptable state.



Table 4. Preliminary List of Toxic Pollutants of Concern, Delaware Estuary Program, July 1994

Pollutant	Rationale	Possible Sources
Pesticides/PCBs/PAHs		
PCBs	Current consumption advisories issued by NJDEP, PADER, and DNREC (Greene and Miller, 1994). Sediment contamination (Costa and Sauer, 1994; EMAP, 1994).	Nonpoint sources including Superfund sites
PAHs*	Observed sediment toxicity and exceedances of NOAA effects levels (ER-L and ER-M) (Costa and Sauer, 1994; DRBC, 1993; EMAP, 1994).	Nonpoint sources including atmospheric deposition
DDT, DDE & DDD	Elevated tissue levels in fish and birds. Recent data (1990) collected by DRBC indicates levels exceeding 10^{-6} risk level. Possible exceedance of chronic aquatic life WQC for DDD. Sediment contamination (EMAP, 1994).	Nonpoint sources (runoff from existing or abandoned sites); point sources (DDD - 12 discharges)
Dieldrin	Recent data (1990) collected by DRBC indicates levels exceeding 10^{-6} risk level	Nonpoint sources including abandoned sites (Cobbs Creek, PA)
Chlordane	Current consumption advisories issued by NJDEP and PADER. Recent data (1990) collected by DRBC indicates levels exceeding 10^{-6} risk level.	Nonpoint sources
Metals		
Lead	Possible exceedance of chronic aquatic life WQC. Monitoring data for 1992 indicate exceedances of proposed WQC in the lower Estuary (River Mile 60.6 and 66.0).	Point sources (53 discharges); Nonpoint sources?

Pollutant	Rationale	Possible Sources
Zinc*	Elevated levels in shellfish tissue. Christina River ambient water quality criteria exceeded. Exceedance of ER-M in much of Estuary (Costa and Sauer, 1994; DRBC, 1993; EMAP, 1994).	Point sources (83 Discharges)
Copper	Possible exceedance of chronic aquatic life WQC. Monitoring data for 1992 indicate exceedances of proposed WQC in the lower Estuary (River Mile 60.6, 66.0 and 71.0). Sediment contamination (EMAP, 1994).	Point sources (58 discharges); Nonpoint sources?
Mercury	Possible exceedance of chronic aquatic life WQC. Sediment contamination (EMAP, 1994).	Point sources (24 discharges); Nonpoint sources?
Arsenic	Possible exceedance of human health WQC for carcinogenic effects.	Point sources (16 discharges); Nonpoint sources?
Chromium	Possible exceedance of chronic aquatic life WQC for hexavalent chromium, but not for trivalent chromium. Sediment contamination (EMAP, 1994).	Point sources (39 discharges); Nonpoint sources?
Silver	Possible exceedance of chronic aquatic life WQC.	Point sources (22 discharges); Nonpoint sources?
Volatile Organics		
1,2 Dichloroethane	Possible exceedance of human health WQC for carcinogenic effects. Monitoring data for 1990 indicate exceedances of proposed WQC between River Mile 71.0 and 107.1.	Point sources (8 discharges); Nonpoint sources?
Tetrachloroethene	Possible exceedance of human health WQC for carcinogenic effects.	Point sources (9 discharges); Nonpoint sources?



DRAFT CCMP

Pollutant	Rationale	Possible Sources
Toxicity		
Chronic Toxicity	Possible exceedance of chronic aquatic life WQC for whole effluent toxicity. Study in November 1990 indicated chronic toxicity of ambient water samples collected at River Mile 69.0, and between River Mile 97.5 and 107.1.	Point sources (51 discharges); Nonpoint sources?

*PAHs and Zinc were added by the Toxics Task Force based on recent data. The original criteria on page 217 were not used to add these substances to the list.

What and How: A Toxics Advisory Committee would be formed by DRBC to coordinate the proposed Toxics Management Strategy. The Toxics Advisory Committee would report, through DRBC, to the Estuary Council. The Committee would consist of appointed members, including a balance among government, the regulated community, and citizens' groups. Members would be appointed by DRBC's Executive Director based on recommendations of the Commission and the Delaware Estuary Program Policy Committee.

The following agencies and organizations would be represented:

- State of Delaware
- State of New Jersey
- State of New York
- Commonwealth of Pennsylvania
- USEPA
- Academic representative
- Environmental/watershed representatives (2)
- Industry representative
- Fish and wildlife representative
- Agriculture representative
- Public health interest representative

In addition, county and local health departments would be represented, as appropriate, and a Delaware Estuary Council representative who is familiar with the Delaware Estuary monitoring program would make regular reports at the meetings. Because such a wide variety of groups must be represented, state and federal agencies should appoint experts in particular areas on a yearly rotating basis (i.e., NJ, nonpoint source; DE, fish and wildlife; PA, water quality). One or two agencies could appoint a representative that would coordinate among the other federal agencies.

Meetings would be held twice a year, or as necessary, to discuss any toxics problems or indications of new problems that need to be addressed. The Toxics Advisory Committee would establish procedures that would be applicable to members and non-members for presenting information to the Committee. Meetings will be open to the public, and citizens will be encouraged to bring their concerns to the committee.

Identify cause or define issues

If a problem is identified, a coordinated effort would be made to find the cause. After consideration by the Toxics Advisory Committee, recommendations would be made to DRBC Commissioners and the

- THE OBSERVED PHENOMENON**
WHO WILL MAKE THE OBSERVATIONS?
1. STATE AGENCIES
 2. FEDERAL AGENCIES
 3. LOCAL GOVERNMENT AGENCIES
 4. ENVIRONMENTAL GROUPS
 5. REGULATED COMMUNITY
 6. ACADEMIA
 7. RESEARCH ORGANIZATIONS
 8. CITIZENS



Estuary Council for more research and/or addition of the pollutant to the list of toxics of concern. The Toxics Advisory Committee should also provide the relative priorities of concerns brought to the Estuary Council.

Action to Mitigate the Problem



If the causative agent is a toxic substance, the Estuary Council may add it to the List of Toxic Pollutants of Concern and/or coordinate and assist in identifying funds for research to more fully define the problem.



The Estuary Council would formally recommend that regulatory agencies characterize sources and loadings and develop specific control strategies. The possible range of control strategies may require legislation, permit modification, and/or further research. If toxic contamination is found, clear communication of the problem to the affected agencies and the public is vital. If the toxic substance is not already part of the Delaware Estuary monitoring plan, the Estuary Council would assure that monitoring for trends and effectiveness of control strategies, either through the regulatory agencies or the Delaware Estuary monitoring program, is implemented.



If the causative agent is not a toxic substance, the Toxics Advisory Committee would bring the problem to the attention of the Delaware Estuary Council for referral.



The Toxics Advisory Committee should be organized and functional by January 1995. Initial priorities would be to review the Preliminary List of Toxic Pollutants of Concern, the selection criteria for listing toxic substances, and determine if changes are needed. Also the Committee should address nonpoint sources of PCB, DDX, and chlordane contamination.

Measure of Success: Establish Committee by January 1995. Control strategies in place and working for identified problems. Success must be confirmed by monitoring results.

POLLUTION PREVENTION, REDUCTION, AND AWARENESS

ACTION T2: Assist Residents in the Proper Use and Disposal of Chemicals

Why: Unwise use of toxic substances by individual residents of the Estuary, small businesses, the fishing community, and farmers contribute to the toxic contamination of the Estuary. This action plan will assist residents in the proper disposal of contaminants and heighten their awareness of the need to protect the Estuary. The activities support the implementation of pollution reduction and public awareness programs by existing regulatory organizations, environmental advocates, school systems, and public officials. In addition implementation of management measures as required by the Coastal Zone Reauthorization Act Amendments (Section 6217) will reduce nonpoint sources of toxic substances.

Measure of Success: Reduction of pesticides in sediment, water, and biota. Increases in quantities of pesticides received by collection programs. Household hazardous waste collection program established in each county within five years. Increases in level of involvement by public.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T2: Proper Chemical Use and Disposal			
T2.1: Public Chemical Usage & Household Toxics Waste Collection	<i>Lead:</i> Counties <i>Partners:</i> Conservation Districts, Cooperative Extension, Health Departments	Mid-term	\$225,000 per year
T2.2: Agricultural Pesticide Collection Program	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> USEPA, States, USDA, Conservation Districts, Cooperative Extension	Mid-term	1st year: \$1.15 Million; subsequent years will cost less
T2.3: Industrial/Commercial Usage	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> States, USEPA, manufacturers	Mid-term	\$100,000



Action T2.1: Develop a Public Education Program on Chemical Usage and Household Toxic Waste Collection

What and How: The counties, with advice from the Delaware Estuary Foundation, will establish programs to educate the public on the environmentally responsible use of home chemicals. These programs would include the use of mass media to disseminate information to the public; literature on proper disposal of home chemicals, including used oil, paints and lacquers, etc. Complete lawn chemical guidance would be provided using existing materials available from the states, federal agencies, or private sources. Information on non-toxic or less toxic substitutes for household chemicals would be included. A needs survey of existing programs would be performed by the Delaware Estuary Foundation to determine which programs must be expanded and the kinds of improvements that need to be made. A successful program that is already underway could be used as a model for counties that have not completed the development of a program.

Distribution of materials and educational seminars would be conducted by health departments, at their offices or at centralized locations. The Delaware Estuary Foundation would solicit volunteers to speak to the public and distribute literature.

County government agencies would implement this plan. A private contractor, chosen by the county government and managed and funded by county government, could also implement the plan.

Action T2.2: Develop and Implement an Agricultural Pesticide Collection Program

What and How: The Delaware Estuary Foundation, working with county or regional agricultural agents or state agencies, would create a program to give farmers a legal and no-cost option to dispose of old pesticides. An educational and public awareness program would be necessary to increase understanding among the farming community on the need to minimize the use of pesticides. Pesticide collection could be either at a central location or through pickups at each farm.

The Delaware Estuary Foundation would coordinate this action with appropriate agencies, through a staff nonpoint source coordinator.

Action T2.3: Develop an Education and Assistance Program for Small Industries and the Commercial Sector on the Use of Chemicals

What and How: The Delaware Estuary Foundation would establish a program to educate and assist small industry and the commercial sector, including golf courses and boat yards, on the responsible use of chemicals. These targeted groups would be encouraged to minimize discharges to Publicly Owned Treatment Works (POTWs) and be provided with cheap disposal and recycling options, whenever possible. Often, smaller industries and the commercial sector do not have access to the education and

engineering expertise necessary to minimize waste. In the implementation of this action, pollution prevention would be stressed. Existing pollution prevention technical assistance programs in the three states should be involved in providing assistance to businesses that generate wastes containing toxic pollutants of concern.

Centralized education could occur at seminars put on by the states. The Delaware Estuary Foundation would coordinate the program, using a staff nonpoint source coordinator and the state pollution prevention technical assistance programs. Some states might have programs that could be modified to include assistance to generators for proper disposal of waste.

LIMITING TOXIC POLLUTANT LOADINGS TO THE ESTUARY

Adverse effects on living resources have been observed in the tidal river portion of the Estuary that may be caused by selected toxic substances. Appropriate regulation of discharges of these contaminants is necessary where levels exceed water quality criteria for the protection of aquatic life and human health or an adverse effect has been associated with a specific toxic substance. The Clean Water Act requires a state to establish water quality standards applicable to its waters, and identify those waters which are not meeting the standards. States must then develop the maximum amount of a pollutant that can be discharged to an entire water body, or portion thereof, on a daily basis, the Total Maximum Daily Load, or TMDL. This daily loading can be further divided and allocated to point sources, nonpoint sources, a reserve capacity for future growth, and a margin of safety.

Actions T3 and T4 embrace and expand upon the current efforts of DRBC, and the states bordering the Estuary, to develop policies and procedures to limit the release of substances that are toxic to humans and aquatic life from point sources discharging to the tidal river. These efforts are nearing completion. Public hearings are planned in the spring of 1995 on recommended water quality criteria for toxic pollutants, and policies and procedures for establishing TMDLs and wasteload allocations for individual point sources (See Recommended Water Quality Criteria for Toxic Pollutants for the Delaware River Estuary, and Recommended Implementation Policies and Procedures: Phase 1 TMDLs for Toxic Pollutants in the Delaware River Estuary—not included in this draft).

Data on the loadings of toxic substances from nonpoint sources are lacking, so existing efforts have focused on loadings from point sources. The Delaware Estuary Program is currently involved in identifying and quantifying the loadings of toxic substances from nonpoint sources.



ACTION T3: *Develop and Adopt Uniform Water Quality Criteria for Toxic Pollutants Which Will Be Used by Regulatory Agencies to Regulate Point and Nonpoint Sources*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T3: Uniform Water Quality Criteria			
T3.1: Water Quality Criteria for the Tidal River (Zones 2 to 5)	<i>Lead:</i> DRBC	Short-term	\$10,000
T3.2: State Water Quality Regulations	<i>Leads:</i> DNREC, NJDEP, PADER, USEPA	Short-term	\$30,000
T3.3: Water Quality Criteria for the Bay (Zone 6)	<i>Lead:</i> DRBC	Short-term	\$75,000

What and How: This action has three parts due to the advanced state of development of criteria for the tidal river and the use of in-kind services from the governmental agencies to perform this task.

Measure of Success: Decreased levels of toxic substances of concern in water, sediment, and fish and shellfish tissue. Water quality criteria and regulations in place by 1995 for tidal rivers and by the spring of 1997 for the Bay.

ACTION T4: Implement Phased Limits on Toxic Pollutants Using the TMDL Concept

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T4: Phased Limits Using TMDLs			
T4.1: Procedures for TMDL Process for the Tidal River (Zones 2 to 5)	<i>Lead:</i> DRBC <i>Partners:</i> DNREC, NJDEP, PADER, USEPA	Spring 1995	\$20,000
T4.2: Formal Adoption of WLAs	<i>Lead:</i> DRBC	Fall 1995	\$100,000
T4.3: Permit Limits for Toxics Using WLAs	<i>Leads:</i> DNREC, NJDEP, PADER	After completion of T4.2	Undetermined
T4.4: Identification of Loadings and Estimates from Landfills	<i>Leads:</i> DNREC, NJDEP, PADER	Mid-term	Undetermined
T4.5: Nonpoint Source Loading Estimates	<i>Lead:</i> DRBC <i>Partners:</i> DNREC, NJDEP, PADER, USDA, USEPA	June 1997	\$275,000
T4.6: Phase 2 TMDL (including pollution allotment trading options)		Long-term	\$300,000
T4.7: Formal Adoption of WLAs and LAs	<i>Lead:</i> DRBC	Long-term	\$150,000
T4.8: Permit Limits for Toxics using WLAs and LAs	<i>Leads:</i> DNREC, NJDEP, PADER	Long-term after completion of T4.7	Undetermined



What and How: This action would result in the establishment of Wasteload Allocations (WLAs) for point sources and Load Allocations (LAs) for nonpoint sources. This action has eight parts due to the advanced state of development of implementation policies and procedures for establishing a TMDL for the tidal river and the use of in-kind services from the governmental agencies to perform this task. Nonpoint toxic sources from active and closed landfills must be identified, quantified, and prioritized for remediation and closure.

Pollutant Allotment Trading (See T4.6)

The development of a program that will promote trading of pollutant loads to achieve water quality objectives at reduced cost will be explored. The action plan for TMDLs must first be implemented. Concurrently, authority for the trading program must be established by state agencies, USEPA, and DRBC. Legislative action may be necessary. Dischargers could avoid costly treatment upgrades to their plants by paying for less costly alternatives including point and nonpoint source controls. This plan could be applied Estuary-wide for both point and nonpoint sources. Nonpoint sources include direct discharges from hazardous waste sites and landfills, atmospheric deposition, groundwater infiltration, urban storm water runoff, agricultural storm water runoff, storm water runoff from industrial sites, and combined sewer overflows.

MITIGATING THE IMPACT OF PCBs, CHLORDANE, AND DDXs

ACTION T5: *Identify the Sources of Contaminated Sediments, Examine the Processes Through Which these Substances are Transported up the Food Chain, and Identify Control Strategies and Mitigation Alternatives*

Why: Sediments serve as both a sink and a source of toxic contaminants. Past and current contamination of the sediments by substances such as PCBs, chlordane, and DDXs (DDT and its metabolites DDE and DDD) has resulted in adverse effects on living resources. DDT and its metabolites have been associated with eggshell-thinning in several bird species. Consumption advisories have been in place for channel catfish and white perch in the upper Estuary since 1989 and were recently expanded to include the lower tidal river and Bay for several additional species, including striped bass.

Immediate action is required to identify the sources of these contaminants, examine the processes through which they are transported up the food chain, and identify control strategies and mitigation alternatives.

Measure of Success: Activities should lead to identification of sources and mitigation when feasible.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T5: Mitigating the Impacts of Contaminated Sediments			
T5.1: Identification of Major Source Categories	<i>Lead:</i> Implementation team (state and federal hazardous waste units)	Spring 1995	\$75,000
T5.2: Recommendations to Fill Data Gaps	<i>Lead:</i> Implementation team <i>Partner:</i> Toxic Advisory Committee	Mid-term	\$175,000
T5.3: Identification of Control Strategies and Costs	<i>Lead:</i> Appropriate agencies	Long-term	\$100,000



Action T5.1: Identify and Rank Major Source Categories and Sinks of PCBs and DDXs

What and How: An implementation team would coordinate the efforts of state and federal agencies to identify and characterize the major source categories and sinks of PCBs, DDXs, and chlordane in the Estuary. At a minimum, the team would consider loadings from tributaries, point sources, air, hazardous waste sites, urban and industrial storm water, combined sewer overflows, and in place sediments. This activity may identify additional pollutants that will need to be mitigated (See Action T1).

Action T5.2: Develop Recommendations to Fill Data Gaps

What and How: The Toxic Advisory Committee and implementation team would develop recommendations for additional monitoring or other studies to fill data gaps and further delineate the extent of sediment contamination and the bioaccumulation pathways.

Action T5.3: Identify Alternative Strategies and Costs

What and How: Appropriate agencies would identify alternative control strategies and associated costs to mitigate the impact of PCBs and DDXs.

FISH CONSUMPTION ADVISORIES

ACTION T6: Develop a Uniform Program for Issuing Fish Consumption Advisories

Why: Although there are several advisories in place for the Delaware Estuary, there are currently no uniform procedures for the detection and evaluation of fish tissue contamination in the Estuary. The states also develop fish advisories independently for the Estuary. There is no coordinated program for informing the public of health risks from consuming tainted fish. The result has been incomplete and inconsistent advice to the public.

Efforts should be coordinated to prevent duplication of effort, maximize resources, and provide clear and consistent information to the public. The three states must work together to develop coordinated monitoring programs, uniform test procedures, and consistent fish and shellfish advisories. Local health departments would be kept informed about advisories and assist in dissemination of information. States would have the option of setting more stringent advisories after a minimum level of protection is agreed upon.

Measure of Success: All procedures completed by spring 1996. A survey of fish consumption could be conducted to evaluate whether the public is following the advice.

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION T6: Fish Consumption Advisories			
T6.1: Memorandum of Understanding	Includes but not limited to: <i>Leads:</i> DNREC, NJDEP, PADER <i>Partners:</i> NJ Department of Health, PA Department of Health, PA Fish and Boat Commission, DRBC, USEPA, USFWS, FDA	Short-term	\$17,000
T6.2: Committee		Short-term	\$100,000
T6.3: Written Procedures for Uniform Methods		Short-term	\$200,000
T6.4: Written Procedures for Health Risk Assessments		Short-term	\$225,000
T6.5: Health Risk Assessments		Long-term	\$75,000 per assessment
T6.6: Risk Management Actions		Long-term	Undetermined
T6.7: Risk Communication Materials		Long-term	\$5,000/yr

Action T6.1: Prepare Memorandum of Understanding

What and How: A Memorandum of Understanding (MOU) would be prepared to serve as a basis for developing inter- and intra-agency consensus on issues affecting fish consumption advisories in the Estuary. As a model, the MOU developed by the State of Delaware would be considered. The MOU would not bind the states to changing present policies, but would include an agreement to coordinate monitoring and work toward more consistent advisories.

Action T6.2: Establish Committee

What and How: A Committee would be established, composed of representatives from signatory agencies of the MOU. The Committee should include individuals with



expertise in fisheries, public health, sampling and analytical procedures, pollution assessment and control, and risk analysis and communication. The Committee should be established concurrent with endorsement of the MOU. The Committee should meet quarterly for the first year, and as mutually agreed thereafter.

Action T6.3: Develop Procedures for Uniform Methods

What and How: Procedures would be developed for uniform collection and analysis methods as agreed upon by the committee. Procedures would be peer reviewed.

Action T6.4: Develop Uniform Risk Assessment Procedures

What and How: Procedures would be developed for uniform health risk assessments and peer reviewed.

Action T6.5: Conduct Health Risk Assessments

What and How: Health risk assessments would be conducted, consistent with procedures developed under actions T6.3 and T6.4, and peer reviewed.

Action T6.6: Recommend Actions

What and How: Possible risk management actions would be recommended.

Action T6.7: Coordinate Risk Communications

What and How: Coordinated risk communication materials would be developed and distributed as agreed by the Committee.

CRITERIA & ASSUMPTIONS FOR LISTING TOXIC POLLUTANTS

The following criteria were used to list toxic pollutants of concern:

1. Fish advisories have been issued or are being considered by any of the states bordering the Estuary for the pollutant listed.
2. Studies conducted by DNREC, DRBC, NJDEP or PADER have found tissue levels of the pollutant in resident fish species which exceed the 10^{-6} risk level, based upon human health criteria proposed by DRBC.
3. Concentrations of the pollutant projected, using a far-field water quality model and a hardness value developed by the Commission for the Estuary, exceed the water quality criteria proposed by DRBC and NJDEP and adopted by DNREC and PADER for the protection of aquatic life (chronic effects).
4. Monitoring data collected by DRBC indicate an exceedance of proposed criteria.

The following assumptions were used in determining the toxic pollutants of concern:

1. Water quality criteria proposed by DRBC as well as those adopted by DNREC establish the level of risk at one additional cancer case in every 1,000,000 humans exposed for a lifetime (70 years) or 10^{-6} . DRBC criteria uses a fish consumption factor of 6.5 grams per day in developing the freshwater criteria, and a fish consumption factor of 37 grams per day in developing the marine criteria (applies below the Delaware Memorial Bridge). DNREC marine water quality criteria also assumes a consumption factor of 37 grams per day. Risk levels and acceptable tissue levels of a pollutant (at 10^{-6} risk level) are derived using the following formula:

$$\text{Risk Level} = 1 - (\exp(-\text{Dose} \times \text{Cancer Potency Factor}))$$

$$\text{Dose} = \frac{(\text{Tissue Concentration (mg/kg)} \times \text{Fish Consumption Rate})}{\text{Body Weight (70 kg)}}$$

2. Statements regarding exceedances of water quality criteria (WQC) are based upon preliminary model runs with the uncalibrated Delaware Estuary Toxics Model (DELTOX). The model runs for chronic aquatic life criteria assessment used the design conditions of 2500 cfs at Trenton, NJ and 7Q10 values for other tributaries. The model runs for carcinogen criteria assessment used the design conditions of 7260 cfs at Trenton, NJ and harmonic mean flow values



for other tributaries. Field studies to provide data to calibrate and validate the model were completed in the fall of 1992.

3. The criteria proposed by DRBC for metals expresses the criteria as total recoverable metal. Statements regarding exceedances of metals criteria are similarly based upon total recoverable metal. For those metal criteria that are hardness-based, the mean hardness during months when the design flow condition occurs (July - October) was used to calculate the numerical value.
4. Exceedances of acute aquatic life criteria in the near-field were not considered in developing this list.
5. Information on possible sources was derived from the survey of 120 discharges from 83 municipal and industrial facilities conducted by DRBC in 1990 and 1991. As part of this survey, discharges conducted three priority pollutant scans using the most sensitive analytical methods, and two chronic toxicity tests using both fish and invertebrates over a three month period.

RIVER MILE REFERENCES	
RK (RM)*	LOCATION
60.6 (36.0)	Pea Patch Island
66.0 (40.3)	New Castle
69.0 (42.1)	Delaware Memorial Bridges
71.0 (43.3)	Cherry Island
97.5 (59.5)	North of Walt Whitman Bridge
107.1 (65.3)	Tacony-Palmyra Bridge

- * RK - River Kilometer
 RM - River Mile
 as measured from the mouth of Delaware Bay.

CHAPTER VII: Education and Involvement Action Plan

One of the Delaware Estuary Program's goals deals directly with the issue of public education and outreach:

To promote greater public understanding of the Delaware Estuary and greater participation in decisions and programs affecting the Estuary

Public support is needed to implement the CCMP recommendations, and this support cannot be obtained without confronting the lack of public appreciation for the Estuary, the lack of knowledge about the interdependence of human and estuarine health, and the lack of public involvement in Delaware Estuary issues. People living in the Estuary region have strong concerns for the environment, but often have little accurate knowledge about the estuarine ecosystem.

A. "Delaware Estuary: Discover its Secrets"

Developing an effective program of outreach and public education is a challenging job for a program with a limited budget and an audience of approximately six million people. It is challenging but it is also essential, since the decisions that we make now will affect the natural heritage that this generation has borrowed from the future.

This Plan — the CCMP — has been developed as a blueprint for restoring and protecting the Estuary. Unlike more traditional planning efforts, the Delaware Estuary Program offered an unusual opportunity; it asked the public to help develop a plan for the resource, rather than accept one prepared by government agencies.

People representing a wide variety of interests — business people, environmentalists, teachers, planners — have helped to shape this Plan. You, the person who cares enough to read this, are the person who can make this Plan a reality.

The Delaware Estuary Program asked the public to help develop a plan for the resources, rather than accept one prepared by government agencies.



The Delaware Estuary Program has supported an active tri-state public involvement and education program since 1989. Fact sheets, posters, workshops, presentations, and media coverage have been used as ways to get our message across. Public meetings, activities funded by mini-grants, and the establishment of a Citizens Advisory Committee (CAC) have been some of the ways we have sought to achieve public involvement.

An important milestone of the program has been the official recognition of Delaware Bay wetlands as internationally important, also known as the Ramsar Convention.

The Delaware Bay system is the United States' eleventh Ramsar site, and the first Ramsar site to include privately owned wetlands. The international recognition that this designation brings will help focus attention on the Estuary's unique and irreplaceable resources.

If you understand the Estuary's water quality problems and possible solutions, you can make informed choices about its protection. But ultimately, if you understand how you fit into the ecosystem, you would make responsible, appropriate lifestyle choices. Information is only one step in an educational continuum involving understanding, awareness, stewardship, new skills, behavioral changes, empowerment, and action. The Delaware Estuary's public involvement program sought to maximize our effectiveness and to avoid duplication of other groups' efforts. We saw our most useful role as providing coordination and filling gaps that we identified in estuarine education.

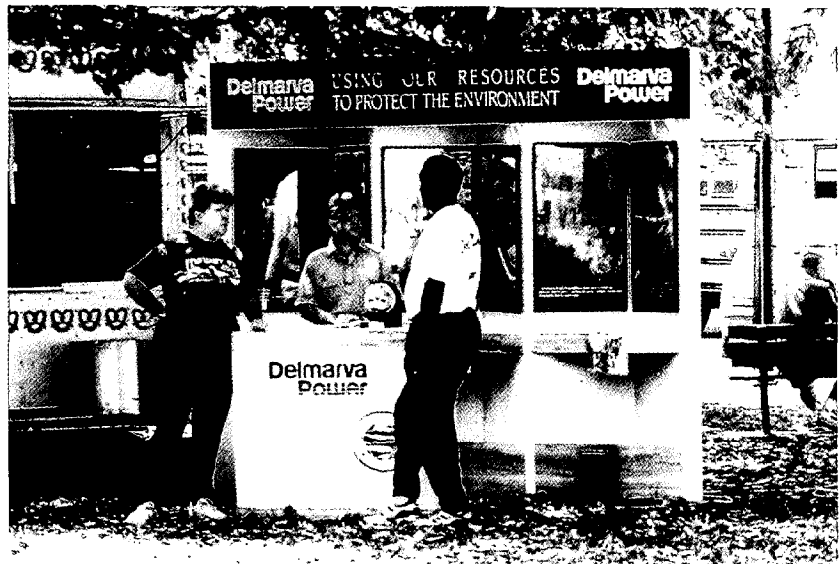















Figure 46. Delmarva Power booth at Festuary 1993: A celebration of the Delaware Estuary. Over 3,000 people attended the event at Delaware City and Fort Delaware State Park, DE, and Fort Mott State Park, NJ. Delmarva Power helped to plan and sponsor Festuary.

B. Analysis of Existing Programs

We began our analysis of existing programs by stating our educational priorities. We believe that increased awareness and understanding leads to increased stewardship of the Estuary's resources. The public should be educated about the following priority issues:

	How individual actions can help or hurt the Estuary
	The Estuary as a functional unit
	Use of indigenous plants
	Harvestable finfish and shellfish
	Migratory populations, including waterfowl, songbirds, raptors, and invertebrates
	Estuarine-dependent mammals, birds, reptiles, and amphibians
	Wetlands values and functions
	Biodiversity and ecological balance
	The benefits of beaches and dunes, and the ecological value of shoreline and littoral habitat
	The relationship of sediment and dredging to water quality and flooding
	Land use
	Toxics
	Sustainable development

We then surveyed existing public education and outreach programs in the three states. We discovered that there are numerous public and private groups in the watershed area that are addressing the issues we deemed important. Many of our CAC and Public Participation Task Force (PPTF) members are active in



other groups who are doing important environmental work. We rely on their valuable input regarding conferences and publications that are being planned. A listing of some of the major environmental education organizations in the Delaware Estuary region follows:

NATIONAL ORGANIZATIONS:

Academy of Natural Sciences
Concern, Inc.
League of Women Voters
National Institute for Urban Wildlife
National Wildlife Federation
The Nature Conservancy
Sierra Club
Water Environment Federation

FEDERAL AGENCIES:

U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish & Wildlife Service

REGIONAL ORGANIZATIONS:

Delaware Bay Schooner Project
Delaware Estuary Program
Delaware River Basin Commission
Riverkeeper Network/Watershed
Association of the Delaware River
Water Resources Association of the
Delaware River Basin

STATE INFORMATION SOURCES:

Delaware

Department of Natural Resources
and Environmental Control
Delaware Cooperative Extension
Delaware Nature Society
University of Delaware Marine
Communications Office
Soil Conservation Districts

Pennsylvania

Department of Environmental
Resources
Pennsylvania Alliance for
Environmental Education
Pennsylvania Cooperative Extension
Pennsylvania Environmental Council
Pennsylvania Fish and Boat
Commission
Soil Conservation Districts

New Jersey

Association of New Jersey
Environmental Commissions
Cape May Bird Observatory
Department of Environmental
Protection
New Jersey Audubon Society
New Jersey Cooperative Extension
New Jersey Sea Grant
New Jersey State Aquarium
The Wetlands Institute
Soil Conservation Districts

EDUCATION AND INVOLVEMENT

Once compiled, we analyzed this list and concluded that many of these organizations target a specific geographic area, or focus on a specific issue. As a regional organization that represents many interests throughout the Estuary, the Delaware Estuary Program has a unique role as a coordinator of a network of complementary, overlapping interests. We can fill gaps through sharing and disseminating information and resources. We are also the only organization that promotes the CCMP and its implementation.

We have devised a public education strategy that provides for different levels of involvement. If another group is addressing an issue adequately, we will help to promote and publicize its efforts. Many of our fact sheets and newsletter articles have spotlighted work being done by both organizations and individuals in the region.

If a group needs financial or logistical assistance we will try to provide it. We have assisted many such efforts through our mini-grant program. Sometimes a relatively small amount of money is all that is needed to help an organization to continue its work, or to re-print a valuable publication and make it available to a wider audience. Only as a last resort, if we identify an educational need that no one else is addressing, then the Delaware Estuary Program will undertake the task.

As an example of our strategy, the Delaware Estuary Program sponsored a forum on the Salem nuclear generating station. This was successful in part because we had four co-sponsors. We later considered sponsoring a similar forum on the main channel deepening, but when we learned that another group was planning such a forum, we publicized their effort rather than compete with them.

The Delaware Estuary Program believes that all citizens should have, within driving distance of their homes, opportunities to have hands-on educational activities relating to the Estuary. These hands-on activities include floating classrooms, outdoor classrooms, guided walks, and opportunities for public access. The states sponsor many of these interactive programs. Again, the Delaware Estuary Program's strategy provides for a variety of responses: first we promote existing programs; secondly, we seek to influence existing programs to change or broaden their focus to incorporate estuarine issues; and finally, we encourage the creation of new programs, when appropriate.

The Delaware Estuary Program believes that all citizens should have, within driving distance of their homes, opportunities to have hands-on educational activities relating to the Estuary.

C. Why an Education and Involvement Strategy is Needed

Citizens need to better understand how their individual voice is crucial and how they can help to influence policy decisions affecting the Estuary. They also need facts about the extent to which a healthy estuarine area provides recreation and supports our industries, and how each person's individual actions can affect the environment. Also, it is necessary to raise general awareness about the Estuary itself, as well as create a specific awareness of the Delaware Estuary Program.

There is a lot of information to present. To disseminate these messages efficiently, a customized approach to public outreach has been designed. The Program seeks to provide the general public with an awareness of environmental problems, while simultaneously approaching targeted audiences with the specific information that the Program feels is important regarding wise use and management of their businesses, their farms, their boats, and their waterfront property. The main groups are as follows:

General public. Citizens will implement the Plan through household practices, lifestyle changes, and voting. The ongoing program will continue to communicate with the general public, both directly and through the media, to act in an environmentally responsible manner and to provide political and consumer spending support for Estuary clean-up and protection.

Students, including elementary, secondary, and college levels, will be reached through curriculum development and through laws such as the Pennsylvania



Figure 47. Norbury's Landing, NJ. Teachers attending an environmental workshop with the Wetlands Institute on a field trip to observe the spring horseshoe crab/shorebird migration on Delaware Bay. (Photo: Bill Buchanan)

EDUCATION AND INVOLVEMENT

Environmental Education Act. Signed in June 1993, this Act requires that the Departments of Education and Environmental Resources develop and implement environmental education programs. Five percent of monies collected from the Pennsylvania Department of Environmental Resources' pollution fines and penalties will be deposited into an environmental education fund which will be used to support new environmental education programs and to provide grants to schools and organizations.

Targeted user groups. Certain groups need to get specialized messages because their actions may have a disproportionate impact on a particular resource of the Estuary. These groups need to be encouraged to take an active role in implementation of the Plan. The outreach tools identified in this Action Plan will be used to reach these groups. Each year, the Delaware Estuary Foundation will set priority issues and corresponding target audiences (See Action E9).



Industries and manufacturing enterprises should be assisted in implementing best management practices and best available technologies which focus on controlling impacts at the source. Such practices can include constructing basins to capture storm water, substituting a more benign raw material for a toxic one, reusing and recycling materials and water, and improving treatment of wastewater.



The way that **farmers** select and grow crops, manage irrigation, use pesticides and other chemicals, and care for their land can have a significant impact on the Estuary and its watershed and on the future quality and quantity of the water supply.



Construction of homes, offices, and large scale developments poses potentially significant problems in land use and impacts to habitat and water quality. Construction can be scheduled to minimize soil erosion. Selection of building sites, location of septic systems, and installation of trenches, check dams, and filter structures, can all minimize environmental impacts.



Waterfront landowners, realtors, home builders, and coastal communities need to be better informed about the benefits of alternative forms of shoreline protection, in replacing bulkheads and protecting eroded shoreline, and the potential effects to their property due to sea level rise.



Just by changing their oil or painting their boats, **anglers and boaters** can inadvertently pollute the very waters that make boating here so enjoyable. These audiences should receive messages about the careful selection of boat paints, techniques for scraping boat bottoms, discharging tank wastes, and slowing down as they approach the shore.



All Delaware Estuary Citizens need to get accurate fish advisory information so they can enjoy eating seafood safely.



Government officials, on all levels, need to better understand how their actions impact the environment and how they can help implement the Delaware Estuary Plan.

D. Public Education Activities

Since 1991, many of the program's activities have been conducted by the Pennsylvania Environmental Council (PEC) and the Association of New Jersey Environmental Commissions (ANJEC). The program has been enhanced and reinforced by PEC/ANJEC's individual programs.

The task force considers these ongoing public education activities valuable and worthwhile, and recommends their continuation.



NEWSLETTER

"Estuary News," the program newsletter, is sent quarterly to over 10,000 subscribers. Three to four thousand additional copies of each issue are distributed at locations such as the New Jersey Aquarium and the Cape May Ferry, and at public events.



FACT SHEETS

Ten fact sheets have been issued, with over 50,000 copies in circulation to libraries, educational institutions, nonprofit groups, and the general public. They summarize research results of the Delaware Estuary Program and provide pertinent information for concerned citizens.



PUBLIC ACCESS GUIDE

Forty thousand copies of "The Delaware Estuary Public Access Guide" were produced and distributed in cooperation with a regional power utility, whose mention of the guide in its monthly billings resulted in hundreds of phone calls.

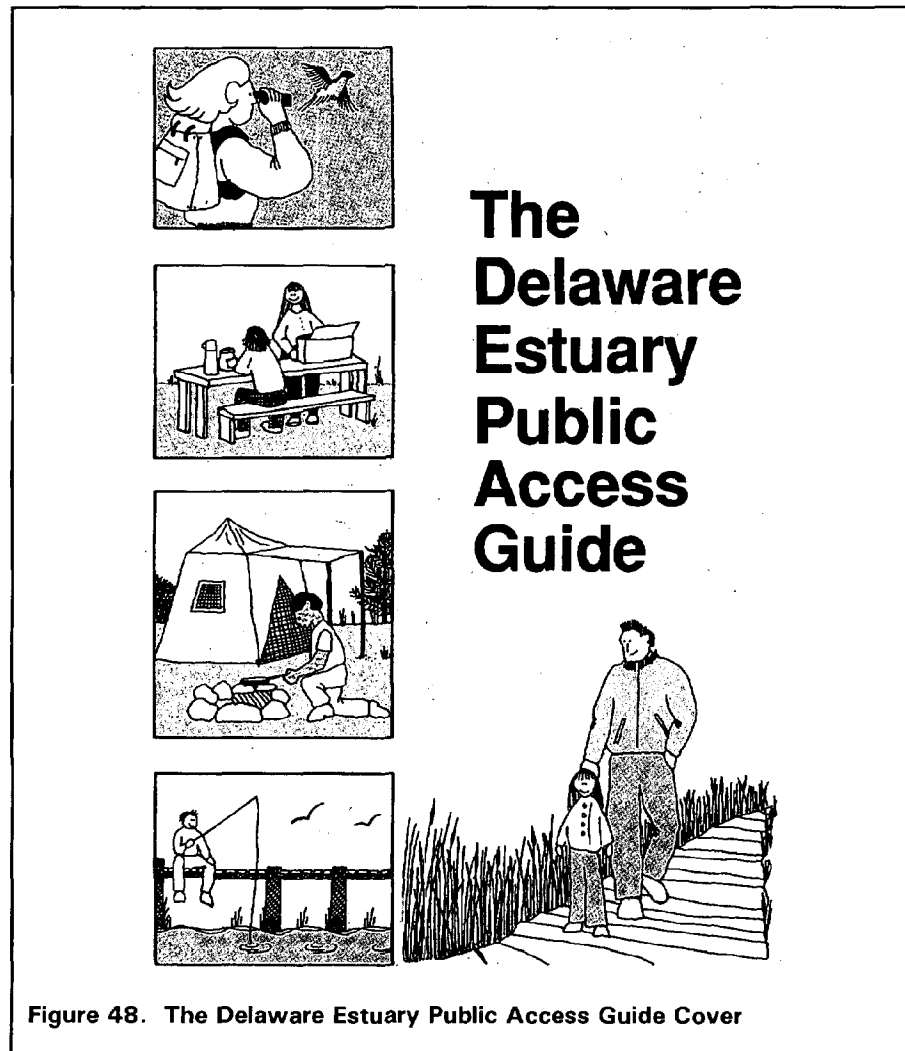


Figure 48. The Delaware Estuary Public Access Guide Cover



DRAFT CCMP



MAP POSTER

A popular poster produced by the U.S. Fish & Wildlife Service has been widely distributed. It features a map of the Estuary and photographs of key species.



SPEAKERS BUREAU/ESTUARY DISPLAYS

PEC/ANJEC staff and many task force members have made over 100 presentations, speaking about the Estuary to Rotary and Kiwanis clubs, wildlife clubs, senate and congressional subcommittees, education associations, and university and high school classes. Traveling displays have been set up and staffed at a variety of trade shows and conferences in the area.

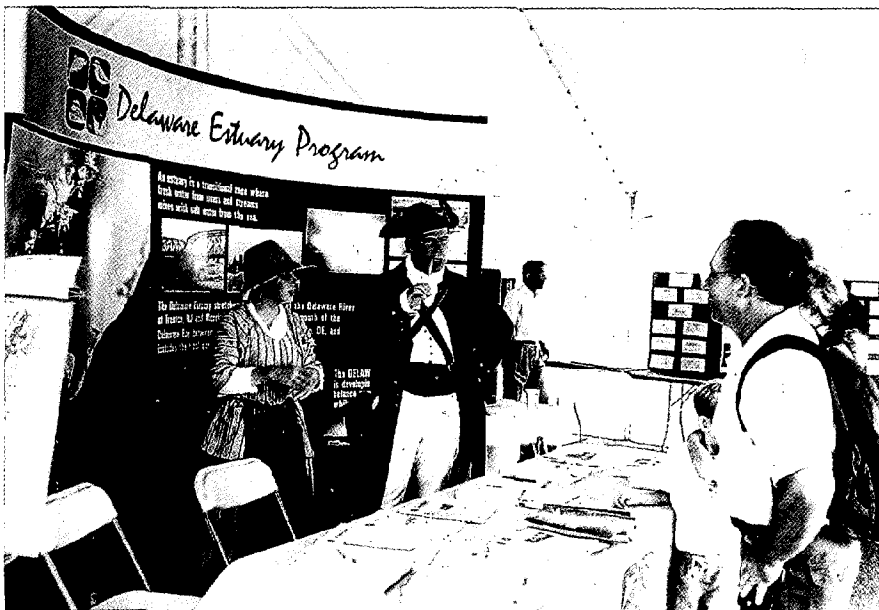


Figure 49. Program booth at the 1994 Delaware River Days at Penn's Landing, Philadelphia, PA. Over 15,000 people visited the booth to hear about Delaware River and Bay history from Stacey Roth and David Emerson.



MEDIA OUTREACH

The Program's media outreach strategy includes public service announcements, cable and public television coverage, press releases, and contributions to area newspapers.



"800" TELEPHONE NUMBER

Over 5000 people per year call the toll free Program-information telephone line to request publications, to get information about regional events, and to establish a personal connection to the program.



CORPORATE OUTREACH

The Program's corporate outreach strategy has included contacts with Public Service Electric and Gas, Atlantic Electric, Delmarva Power and Light, and the Campbell Soup Company. These contacts led to articles on the Program in employee newsletters, articles in company newsletters accompanying monthly utility bills, and full funding of the design and production of 40,000 Program bumper stickers.



RADIO ANNOUNCEMENTS

Radio announcements are produced quarterly through the University of Delaware Sea Grant College



SLIDE SHOW VIDEO

A seven-minute program video, "Where the River Meets the Sea," was produced.

MINI-GRANT PROGRAM

Small projects are funded through the mini-grant program which offers individual grants of up to \$5000 each. Organizations and individuals receive grants to work on projects that increase public awareness of the Estuary or increase participation in efforts to address problems. Since its inception in 1991, 40 grants have been awarded for a total of \$156,200. Activities funded through the mini-grant program vary, but all multiply the number of people educated about the importance of the Estuary and unify the organizers and participants in efforts to enhance and protect the Estuary and its resources.

Forty mini-grants have been awarded since 1991, for a total of \$156,200.

The following are some of the activities funded through mini-grants that have been particularly innovative:

The Friends of Pennypack Park and the Philadelphia Water Department received a joint grant to fund a stormwater sewer



pollution prevention pilot project. The project included surveying local households, painting stencils on storm drains, and distributing door hangers explaining the project. The second survey showed an improvement in public awareness of storm water pollution prevention.

Finn-Tech Industries, and then Limuli Laboratories, have been awarded grants to train volunteers and to conduct an annual horseshoe crab census.

The Gloucester City (New Jersey) Community Development Program held a science fair and festival in May 1992, attended by over 300 students from seven local schools and 200 parents, teachers, and interested neighbors. The event was held in Proprietors Park, an important public access site recently established with Green Acres funding from the State of New Jersey.



Figure 50. Horseshoe Crab Census, Moore's Beach, NJ. Irv Palmer (L) and Peter Himchak (R) work on 1994 horseshoe crab census. Palmer is an education specialist at the NJ State Aquarium and also helps to bleed horseshoe crabs at Limuli Lab. Himchak is with the NJDEP Division of Fish, Game and Wildlife. Both volunteered for the census. (Photo: Bill Buchanan)

The Nature Conservancy in Pennsylvania was awarded a grant for its Bristol Marsh Education and Restoration Program. This program focused on improving habitat protection in this rare freshwater tidal marsh in an urban and industrial setting.

ACTION PLAN DEMONSTRATION PROJECTS

The Delaware Estuary Program identified several local problems that could be addressed quickly through demonstration projects. These action plan demonstration projects are designed to get

experience in problem identification and solution implementation on a small scale, and to provide a basis on which cost and time requirements for larger projects and the CCMP as a whole may be based. The projects which were chosen addressed problems relating to nonpoint source pollution, local waterway management and planning, seafood production, and endangered species habitat.

One particularly successful project, the Red Clay Creek Project, involved the development of best management practices for reducing nonpoint source pollution generated by growing mushrooms, a major agricultural business in Pennsylvania. The Red Clay Creek is a major tributary of the Christina River and is a source of drinking water for the city of Wilmington. With a \$142,000 grant from the program and a \$47,333 county match, the project was able to control runoff with a few relatively simple measures.



Figure 51. An Action Plan Demonstration Project at Red Clay Creek involved the development of BMPs for reducing pollution associated with growing mushrooms.

The success of this project has led to the development of water quality management plans for 20 other agricultural operations in the watershed. Tours of the three participating farms are given on a regular basis, and the success of the best management practices has been written about in several newspapers and magazines. Of equal importance, the project has significantly improved working relationships among county officials and farmers.



E. Public Involvement in the Program

The CAC represents a broad spectrum of major users and interest groups of the Estuary. The membership includes representatives of industry, municipalities, civic associations, and environmental groups from all three states. As a direct link between the general public and the study managers, the CAC is part of the formal structure of the Program. CAC members keep their constituents informed of estuarine issues and progress, and, in return, make the concerns of their members known to the Program staff. They debate, draft, and review the policies that become the framework for the CCMP. The organizations represented in the CAC have a strong voice when acting together to protect and restore the Estuary.

Following the release of the Preliminary Conservation and Management Plan (PCMP) in 1992, the program made a concerted effort to explain the issues and receive input from the public. Press releases were mailed, a concise summary of the PCMP was distributed, a public comment guide was prepared, a special issue of the newsletter was mailed to 9,000 individuals and groups, and eight public meetings were organized around the Estuary so that individuals would have the opportunity to provide crucial input to the process.

CAC members keep their constituents informed of estuarine issues and progress, and, in return, make the concerns of their members known to the Program staff.

Recommendations

Proposed actions provide opportunities for public education about the Estuary and community involvement, at the individual and organizational levels, in carrying out activities. All of the following public education and involvement actions will be used to further the goals and objectives of the Delaware Estuary Foundation and the Delaware Estuary Council. These two organizations will use these actions to disseminate information on their activities, new research findings, proposed policies, how individuals can help to implement CCMP actions, the status of CCMP implementation, and to provide information on how individuals can become involved in commenting on or participating in developing and implementing Council and Foundation plans and activities.

The philosophy of the Delaware Estuary Program is to build partnerships and focus the creative energies and talents of individuals and organizations throughout the region in addressing these identified needs. Sustainable development is a major theme of the program and will be addressed, as appropriate, in all of the proposed actions. All paper products will be printed on recyclable paper and, to the extent possible, products will be available electronically and at resource centers for on-site use.

ACTION E1: Continue Existing Public Participation Program

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E1: Existing Public Participation Program	<i>Lead:</i> Delaware Estuary Foundation w/ advisory committee input; products to be developed by Foundation or others	Short-term	Approximately \$200,000 per year



DRAFT CCMP

What and How: The Delaware Estuary Program initiated a public participation program in 1989. The Public Participation Program is described in detail at the beginning of this chapter. The following activities will continue to be meaningful after the CCMP is completed:

- | | |
|---|--|
| ✧ "Estuary News" newsletter | ✧ Radio actualities (pre-recorded public service messages) |
| ✧ Mailing list maintenance | ✧ Corporate outreach |
| ✧ A speakers bureau | ✧ Media outreach |
| ✧ Mini-grants | ✧ Displays |
| ✧ Updates of slide shows and videos | ✧ Toll-free telephone line |
| ✧ Bi-annual reports | ✧ Fact sheets |
| ✧ Updates of existing public access guide | ✧ Existing posters |

The components should not be funded separately; together, they form an integrated public education program. The \$200,000 per year estimate would include the salary of a public participation coordinator who would convene an advisory committee to provide input on all public participation activities. Subcontractors may be used to complete individual tasks. The States of Delaware, New Jersey, and Pennsylvania should commit to funding this item and participating on the advisory committee. Federal agencies, local governments, and stakeholder organizations should also be involved on the advisory committee. Efforts should be made to enhance existing activities with similar purposes before initiating new activities. All activities included under this action should be used to reach the targeted audiences identified in Action E9.

Measure of Success:

- ✧ 5 to 10% increase in mailing list annually
- ✧ Requests for 15 to 20 speakers annually
- ✧ Public demand for printed materials
- ✧ 100 calls to the toll-free number per month
- ✧ A media story on the Estuary each month
- ✧ Continued interest in the mini-grant program

EDUCATION AND INVOLVEMENT

ACTION E2: Hold and Attend Public Meetings and Workshops

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E2: Public Meetings and Workshops	<i>Lead:</i> Delaware Estuary Foundation in partnership with other organizations	Short-term	\$500 per workshop/ forum

What and How: This action recommends continuation of public forums to discuss issues of importance to the Delaware Estuary, attending public meetings and workshops to promote Estuary issues, and sponsoring workshops to educate and train targeted groups on particular issues of interest relating to the Estuary. Public forums would be organized by the Foundation, either independently or in conjunction with other interested parties on an as-needed basis to be determined by the Foundation Board. Foundation staff and volunteers would attend targeted public meetings and workshops sponsored by other organizations, including, but not limited to, town council meetings, conferences, and seminars in order to promote Estuary issues of interest to the audience at each meeting. In addition, three teacher workshops would be sponsored (one in each state) per year by the Foundation, and the Foundation would work with other educational organizations to incorporate Delaware Estuary Program material into existing teacher workshops.

Measure of Success: 100 people attended the Salem Nuclear Power Plant mitigation discussion sponsored by Delaware Estuary Program; attendance at future public forums should be similar. Attendance by 20 educators at each educator workshop. Commitment for change by audiences at workshops and forums.



ACTION E3: Continue Holding Annual Events to Raise Public Awareness of the Estuary

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E3: Annual Events	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	Approximately \$25,000 per year to cover event expenses, including staff time, comfort stations, ferry service, trash collection, rentals, etc.

What and How: Festivals designed to draw people to the waterfront would be hosted/sponsored annually by the Delaware Estuary Foundation, with the goal of providing at least one event within an hour's drive from all areas in the Estuary. Each festival would have an Estuary theme and offer hands-on activities, resource-related educational materials and displays, and opportunities for involvement and participation. The Delaware Estuary Program has instituted such an event (Festuary), as has the University of Delaware (Coast Day), the Delaware Bay Schooner Project (Bay Day), and Penn's Landing (River Days). The Foundation should continue Festuary and provide input/assistance as needed for other ongoing events, as well as institute new events as the need arises.

The Delaware Estuary Foundation should establish a steering committee to plan and oversee festival activities. The States of Delaware, New Jersey, and Pennsylvania, appropriate local governments, site representatives, and other interested groups should participate on the steering committee, as well as provide displays or presentations at the event. Corporate sponsors should be sought to offset expenses. The focus of the event should be primarily educational and should highlight the natural resources and uses of the Estuary.

Measure of Success: Annual increases in attendance. Increases in participation in planning and sponsorship of the event from Estuary stakeholders. Increases in media coverage.

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ACTION E4: *Develop Educational Initiatives in Support of the Land Management Action Plan*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E4: Educational Initiatives in Support of the Land Management Action Plan	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	\$2500 to print materials per year

What and How: This action provides for development and distribution of mini-courses/material for the general public, college-level classes, or professional courses (and workshops for targeted audiences) that explain land use management decision-making processes, management techniques for each of the major cities and all of the counties in the Estuary watershed, and the opportunities for public involvement in these processes, and how local residents can contribute to the control of nonpoint source pollution. The Delaware Estuary Foundation should work with state and local organizations, whenever possible, on the mini-courses to maximize resources and eliminate possible duplication of effort. Existing materials should be evaluated for adaptation and use before new materials are developed.

Measure of Success: Attendance of ten individuals at each mini-course. Need to reprint materials annually.



ACTION E5: Develop Educational Initiatives in Support of Water Use Action Plan

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E5: Educational Initiatives in Support of Water Use Action Plan	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	\$5000 to print materials or produce public service announcements annually

What and How: This action provides for the development and distribution of materials and public service announcements for the general public (and workshops for targeted audiences) that explain the water budget for the Estuary and its tributaries, water quality conditions at primary-contact recreation areas, how boater behavior can affect the Estuary, the need and economic benefits of water conservation, the impact of stream flow diminution on water supplies and living resources, the value of maritime commerce to the region, the potential beneficial uses and impacts of dredged spoils, how certain land use practices can impact water quality, and low-impact public use of recreational resources. Other activities, such as educational signs at recreational areas and boat ramps, should also be considered. The Delaware Estuary Foundation should work with state and local organizations, whenever possible, on producing materials and workshops to maximize resources and eliminate possible duplication of effort. Existing materials should be evaluated for adaptation and use before new materials are developed.






Measure of Success: To satisfy demand, 20,000 Delaware Estuary Program public access guides are printed per year. Responses to surveys indicate an increase in use of water conservation measures.

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ACTION E6: *Develop Educational Initiatives in Support of the Habitat and Living Resources Action Plan*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E6: Educational Initiatives in Support of the Habitat and Living Resources Action Plan	<i>Leads:</i> DNREC, NJDEP, PADER <i>Partners:</i> Appropriate private and public educational institutions	Short-term	Approximately \$10,000 per year per state

What and How: Curricula, mini-courses, portable displays, and activity kits would be developed that increase awareness and understanding of:
Courses should be targeted for school children, grades K-college, educators, and the

-  The importance of harvestable finfish and shellfish and their ecological requirements;
-  Wetlands values and functions;
-  Shoreline values and their protection;
-  Watershed-scale approaches to conserving biodiversity; and
-  The Delaware Estuary as a functional unit and how individual actions affect estuarine resources.

public. Subjects will be identified in Needs Assessments conducted by State Aquatic Resources Education Programs. The portable displays and activity kits should be available to loan out to environmental educators in each state. Also training and in-service programs should be developed for teachers and workshops should be conducted for targeted audiences. State agencies should work with state and local educational organizations, such as the departments of public instruction, science teacher associations, and environmental education associations, whenever possible, to ensure coordination with established curricula and to avoid duplication of effort.









Existing materials should be evaluated for adaptation and use before new materials are developed.

Measure of Success: Attendance by 20 educators at each mini-course and demand for additional mini-courses on the items listed above. Ten or more requests to borrow displays and activity kits per year.

ACTION E7: *Develop Educational Initiatives in Support of the Toxics Action Plan*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E7: Educational Initiatives in Support of the Toxics Action Plan	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	\$2000 to print material per year

What and How: Using various educational tools (newsletters, workshops, etc.), the Delaware Estuary Foundation should develop and implement a strategy for educating the public and targeted audiences on:

-  The proper use and disposal of household hazardous wastes;
-  The proper use and disposal of agricultural pesticides;
-  The proper use and disposal of industrial/commercial hazardous wastes;
-  Any fish consumption advisories in the Estuary;
-  Less hazardous and reduced chemical farming practices; and
-  Non-toxic or less toxic alternatives to household hazardous substances.

The Delaware Estuary Foundation should work with state and local organizations, whenever possible, on educational materials and programs to maximize resources and

EDUCATION AND INVOLVEMENT

eliminate possible duplication of effort. Existing materials should be evaluated for adaptation and use before new materials are developed.

Measure of Success: Reduction of pesticides in sediment, water, and biota. Increases in quantities of pesticides received by collection programs. Increases in number and frequency of household hazardous waste collection programs in each county. Increases in level of involvement by public.

ACTION E8: *Conduct and Publish Public Attitude Surveys*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E8: Public Attitude Surveys	<i>Lead:</i> Delaware Estuary Foundation	Initiate in 1995; every five years thereafter	Supplies & materials \$5,000

What and How: The Delaware Estuary Foundation should publish a public attitude survey during 1995 (6th year of program). This will establish a baseline of public knowledge about the Estuary. It will also quantify the public's stated willingness to change individual behavior to help improve the Estuary. Eleven thousand surveys would be distributed in the newsletter. Another 11,000 surveys should be distributed through other vehicles. Every five years thereafter, the Delaware Estuary Foundation should repeat the survey to measure attitude changes.

Measure of Success: An increase in public knowledge and concern for the Estuary as indicated by each 5-year survey.



ACTION E9: Determine Priority Educational Messages and Targeted Audiences

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E9: Target Audiences	<i>Lead:</i> Delaware Estuary Foundation	Annually	Covered under E1

What and How: Each year the Delaware Estuary Foundation will determine which of the Plan's recommendations should be implemented. This decision would lead to a determination of educational messages and targeted audiences. The priority educational messages would then become the themes of the newsletter, press releases, workshops, and other educational activities described in this chapter. The public education and outreach staff would determine the best methods to get these messages to the targeted audiences.

Measure of Success: The measures of success are covered by the other action items.

ACTION E10: Promote Ecotourism in the Estuarine Region

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E10: Ecotourism in the Estuarine Region	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate state and local entities	Short-term	Approximately \$10,000 per year per state

What and How: Delaware Estuary Foundation staff should work with tourism offices and economic development interests to provide information on ecotourism opportunities and barriers and to include opportunities in tourism advertisements and information packets.

Local officials and land owners should be involved in the development of any ecotourism materials that would bring tourists to their areas, to determine which areas should be targeted for tourism and which areas should be preserved for undisturbed habitat.

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Measure of Success: Information included in tourism advertisements and information packets. Increase in sales and other revenues accruing to local businesses stemming from the increase in ecotourism. Development of the infrastructure to meet the needs of tourists and construction of visitor centers, marine facilities, and recreational facilities.

ACTION E11: Encourage use of Citizen Monitoring Activities and Best Available Technology for Monitoring

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E11: Citizen Monitoring Data and Use of Best Available Technology	<i>Lead:</i> State natural resources agencies <i>Partners:</i> USEPA, DRBC	Short-term	\$25,000 per year per state

What and How: The Delaware Estuary Program has identified specific monitoring needs and objectives. Citizen monitoring of water quality, species diversity and density, and habitat quality should be used wherever possible to fulfill these monitoring needs and objectives. Monitoring results (synthesized data, trend analysis) would be publicized in the Program newsletter.

Staff from DNREC, PADER, and NJDEP should work with existing groups who are organizing citizen monitoring programs throughout the Estuary, such as the Riverkeeper Network, Delaware Stream Watch, Stroud Water Lab, and the Watershed Association's monitoring program, and encourage the use of best available technology for monitoring activities.

Measure of Success: Creation of an open exchange among the various citizen monitoring programs. Generation of data that is actively used by management agencies and improved standardization of methods among citizen monitoring groups.



ACTION E12: Promote "Hands-On" Educational Activities and Volunteer Stewardship Opportunities

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E12: "Hands-On" Educational Activities and Volunteer Stewardship Opportunities	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	Covered under E1

What and How: Foundation staff should work to incorporate Delaware Estuary information into existing hands-on and volunteer programs, promote participation in existing programs, and encourage development of new programs where none exist. A first step to implementing this recommendation would be to prepare an inventory of existing programs and determine spatial gaps in offerings. Examples of volunteer stewardship opportunities include the horseshoe crab census, river cleanups, and adopt-a-wetland programs.

Measure of Success: Offering of one or more hands-on activities/volunteer opportunities at locations within 10 miles of all elementary and secondary schools in the estuarine basin.

ACTION E13: Support Floating Classrooms

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E13: Floating Classrooms	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	Covered under E1

What and How: There are currently no educational programs that provide individuals with environmental educational opportunities on the Estuary. The Delaware Estuary Foundation should support efforts by other organizations to implement floating classrooms that teach the public and targeted audiences about the Estuary.

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Measures of Success: Having a floating classroom visit all interested coastal communities by May 1996.

ACTION E14: *Develop and Publish Outreach Articles in Trade Magazines and Journals*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E14: Outreach Articles in Trade Magazines and Journals	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Short-term	Covered under E1

What and How: This action provides for the development and publication of articles, in appropriate trade publications for targeted audiences, to explain specific management practices for reducing pollution impacts to the Estuary, programs that have worked effectively in other states, and emerging estuarine resource issues. The Delaware Estuary Foundation should encourage editors of the targeted publications to either prepare appropriate articles or to publish articles submitted by the Foundation or state/local organizations.

Measure of Success: Letters to the editors in response to articles and three articles published every year.



ACTION E15: Meet the Demand for Existing and New Publications that will Increase Public Awareness

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E15: Production of Public Education Products	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Mid-term	* See below

What and How: Several publications that would increase public awareness of the Delaware Estuary should be produced; for example, an historical and cultural guide is a missing and necessary component of the Program, which could provide a different approach to reach target audiences. Other items might include: a calendar of photographs, paintings, or other artwork that highlights public events and Program information; a pamphlet on activities that citizens can undertake to enhance the environment; and a poster promoting a positive "vision" of the Estuary. All publications should be produced in partnerships with appropriate organizations. For example, the calendar should be produced in association with regional art leagues. Federal, state, and local governments should provide technical advice and information on historical and cultural sites in their jurisdiction. No publication should be initiated until it is determined that similar publications do not exist.

*** Resource Needs:** Approximately \$15,000 to develop the cultural and historical resources guide and print 20,000 copies; approximately \$10,000 to develop the "What You Can Do" guide and print 20,000 copies; approximately \$30,000 to develop and print 10,000 calendars, which could be sold to reduce the cost; approximately \$15,000 to develop and print 20,000 posters. The publications should be funded through donations, except for staff time spent providing technical advice on the guide.

Measure of Success: Demand for the guides and poster requires reprinting every two to three years. Demand for the calendar is sufficient to justify an annual printing. Increased visits to historical and cultural sites by the public. Federal, state, and local governments provide technical advice and information on historical and cultural sites in their jurisdiction.

EDUCATION AND INVOLVEMENT

ACTION E16:	<i>Utilize Electronic Bulletin Boards to Disseminate Information</i>
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ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E16: Electronic Bulletin Boards to Disseminate Information	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	Covered by the RIMS Action Plan

What and How: Electronic bulletin boards are becoming one of the easiest and most cost effective ways of transferring information. Bulletin boards provide a unique access to individuals who might not have other opportunities to obtain information about the Delaware Estuary. The Delaware Estuary Program hopes to establish a Regional Information Management Service that will include an electronic bulletin board (See Chapter IX). The Program should also contact and work with universities to provide access to national and regional bulletin boards such as Internet, DNREC On-Line, the Delaware Division of Public Health's bulletin board, the Delaware Department of Agriculture bulletin board, the South Jersey Resource Conservation and Development District bulletin board, and the Nonpoint Source Pollution Bulletin Board. Other bulletin boards would be investigated for their suitability. Access is both for the Delaware Estuary Foundation and for other users.

Measure of Success: At least 50 requests for information are advertised on the bulletin boards per month.



ACTION E17: Establish Estuarine Resource Sections Within Existing Libraries and Environmental Centers

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E17: Estuarine Resource Sections Within Existing Libraries and Environmental Centers	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	Approximately \$30,000 the first year & \$1,000 thereafter.

What and How: The Delaware Estuary Program receives numerous requests for reports every month. Providing Estuary materials at strategic locations should be more cost effective than sending the materials out to individuals. Existing facilities should establish Estuarine Resource Sections to provide the public with information about the Estuary. The information should include all reports, videos, and other items published by the Delaware Estuary Program, a bibliography of other available scientific reports or literary works on the Estuary, and, where they are available, a list of resource people and a list of speakers. In addition, computer terminals should be available at the centers to provide access to RIMS and other information networks.

Existing libraries and environmental centers should be contacted to determine if they would serve as a resources center. The regional community would participate in the selection of sites. Staff would be responsible for sending all information to the centers on a periodic basis. Availability of centers would be advertised through newsletters, public events, and press releases.

Measure of Success: Establishment of six new Estuary Resource Sections. Reports from the centers that at least 10 people per month are using the materials.

EDUCATION AND INVOLVEMENT

ACTION E18: Organize and Implement Storm Drain Stenciling Programs

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E18: Storm Drain Stenciling Programs	<i>Lead:</i> Local governments/sewer authorities <i>Partners:</i> Environmental groups, civic associations	Mid-term	Less than \$5,000 per municipality (\$10,000 per year)

What and How: This action provides for a volunteer program; volunteers would use stencils and spray paint at storm drains to convey the message that the storm drain goes directly to the Estuary. Stenciling would be coupled with public service announcements and educational materials that teach the public not to dump oil or other wastes down storm drains.

Measure of Success: Implementation and maintenance (re-painting) of programs in two municipalities per year.

ACTION E19: Urge School Administrators to Incorporate Estuary Education in Curricula and Establish Challenge Grants

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E19: Educator Briefings and Challenge Grants for Schools	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Mid-term	Approximately \$50,000 per year should be made available in grants; \$25,000 per year to administer the program

What and How: The Delaware Estuary Foundation should arrange meetings with school administrators (i.e., school board members and superintendents) to urge them to incorporate estuarine education into their school curricula through a whole language approach. A model policy should be prepared for school board consideration, such as the policy on environmental education developed by the Riverton Board of Education. A grant program should be established which provides matching funds to schools that



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adopt the policy for use in developing whole language curricula, provide Estuary-based environmental education and field trips, and environmental libraries. Availability of grants would be advertised annually and the Foundation would meet with at least 10 school districts per year. Whenever possible, this effort would be coordinated with existing organizations that offer similar programs to maximize resources and streamline the application process.

Measure of Success: Demand for the grant funds. Adoption of the model policy by three school boards per year.

ACTION E20: *Develop and Place Permanent Estuary Displays*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E20: Permanent Estuary Displays	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	Approximately \$5,000 to \$15,000 per display & \$1000 per yr. for display repairs and maintenance

What and How: The Delaware Estuary Foundation should place permanent displays in locations around the Estuary that are visible to a large audience, such as ferries, the New Jersey State Aquarium, Penn's Landing, State Parks bordering the Estuary, and visitor centers. The Foundation should negotiate donated space in the various sites identified and develop appropriate displays, with community input.

Measure of Success: Establishment of one new display per year.

EDUCATION AND INVOLVEMENT

ACTION E21: *Develop a Mascot for the Estuary*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E21: Mascot for the Estuary	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	Approximately \$5,000 to \$10,000

What and How: The Delaware Estuary Foundation, with public input, should identify an appropriate mascot character for the Estuary, such as a horseshoe crab or a historical figure. A costume should be designed and used at public events. A caricature of the mascot should be used in printed materials. Volunteers would be asked to wear the costume at public events.

Measure of Success: Positive public response to the mascot.

ACTION E22: *Establish Delaware Estuary Merit Badge*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E22: Delaware Estuary Merit Badge	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Scouting and youth organizations	Mid-term	\$1,000 per badge design

What and How: The Delaware Estuary Foundation should work with scouting groups, and other youth groups, to establish merit badges for the Delaware Estuary. The merit badge should be awarded when an individual has completed an activity that demonstrates individual action or responsibility for the health of the Estuary.

Measure of Success: Adoption of a Delaware Estuary Merit Badge by one scouting or youth group per year.



ACTION E23: *Develop and Place Watershed Signs on Roadways and Promote Watershed Education*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION E23: Watershed Signs on Roadways and Watershed Education	<i>Lead:</i> Delaware Estuary Foundation <i>Partners:</i> Appropriate public and private entities	Mid-term	\$5000 to produce and place signs per year

What and How: The Delaware Estuary Foundation should work with Departments of Transportation and other roadway authorities, local governments, and watershed associations to place signs along major roadways that indicate when a traveler is entering the Delaware Estuary's (or one of its tributary's) watershed or incorporate the Delaware Estuary logo on existing signs. The signs could also include other important information, such as the number of people relying on the watershed for drinking water. The watershed signs would re-enforce the concept of watershed and instill a sense of ownership for individual watersheds.

Measures of Success: Placement of watershed signs on one major roadway per year in the Estuary region.

CHAPTER VIII: Monitoring Action Plan

Historically, monitoring activities in the Delaware Estuary have been designed to address regulatory needs. Ambient water quality monitoring of the Estuary has provided managers with an indirect evaluation of the regulatory compliance of municipal and industrial dischargers to the system by assessing if water quality standards are being met and designated uses are being achieved. A major thrust of living resources monitoring has been to evaluate commercial and recreational fisheries and to set catch limits.

The regional environmental monitoring plan that has been developed by the Delaware Estuary Program ad hoc monitoring committee will provide information 1) to measure the effectiveness of implemented action plans, 2) to evaluate the ecological health of the Estuary, and 3) to enhance our understanding of the ecosystem. It incorporates ongoing monitoring activities, with some modifications, and is intended to be a cooperative effort of the three states, the federal government, and industry. Regional coordination and integration of ongoing monitoring activities can reduce overlap and duplication, increase efficiencies in data collection and analyses, improve our ability to compare results between monitoring programs, and provide the Estuary-wide perspective needed to effectively manage our estuarine resources.

The environmental monitoring plan is focused on the key areas of water quality, toxics, living resources, and habitat/land cover/land use. Four goals were developed by the ad hoc committee:



To measure current status and trends in indicators of the condition of the Delaware Estuary (and surrounding watershed) on a system-wide basis with known confidence.



To obtain information on variables that may influence the condition of the Delaware Estuary and to assess environmental indications of achievement of management goals set by local, state, and federal authorities.



To estimate the areal extent of the critical landscapes of the Delaware Estuary system with known confidence.

The regional environmental monitoring plan incorporates ongoing monitoring activities, with some modifications, and is intended to be a cooperative effort of the three states, the federal government, and industry.



To evaluate and revise, periodically, the monitoring plan and action plans to address dynamic developments in the Delaware Estuary.

The ad hoc committee developed specific monitoring objectives for each of the key areas based on existing conditions in the Estuary, with the intent of detecting direction and magnitude of change from these conditions. Existing monitoring programs were evaluated to determine how well they met the defined objectives. Proposed modifications and/or expansions to these existing programs were then developed to achieve the Delaware Estuary Program's monitoring goals and objectives. These include new monitoring activities that would significantly increase knowledge of the system and the ability to evaluate the ecological health of the Estuary. This two-tiered approach (a minimal plan and an expanded plan) for each of the key areas is described below:

A. Water Quality Monitoring

MINIMAL PLAN

For the Estuary proper, DRBC center-of-channel, surface only, sampling for water column chemistry and microbiology is considered adequate, if additional stations are added to the 18 stations currently sampled. New stations should include one station upstream near Trenton and three stations to extend sampling to the mouth of the Bay (See Figure 52). Bi-weekly sampling from March to November should remain unchanged. Additional parameters should include algal speciation and primary productivity. The cost estimate for these modifications is \$200,000 per year if the ongoing program is fully funded. This center-of-channel sampling should be augmented with 1) continuation of sampling by New

OBJECTIVES:

WATER QUALITY AND TOXIC SUBSTANCES



To measure status and trends in water quality parameters and toxic substances which relate to overall ecosystem health. To evaluate areal extent and trends in parameters that define the habitat requirements of important aquatic resources. Specific criteria of success for individual parameters will evolve over time with evaluation of trends.



To measure status and trends in water quality parameters and toxic substances which relate to impacts to public health. Specific regulatory criteria will guide evaluation of these status and trends.

In addition to these two objectives, monitoring should provide estimates of loadings to the Estuary based on head-of-tide inputs and effluent point source input data.

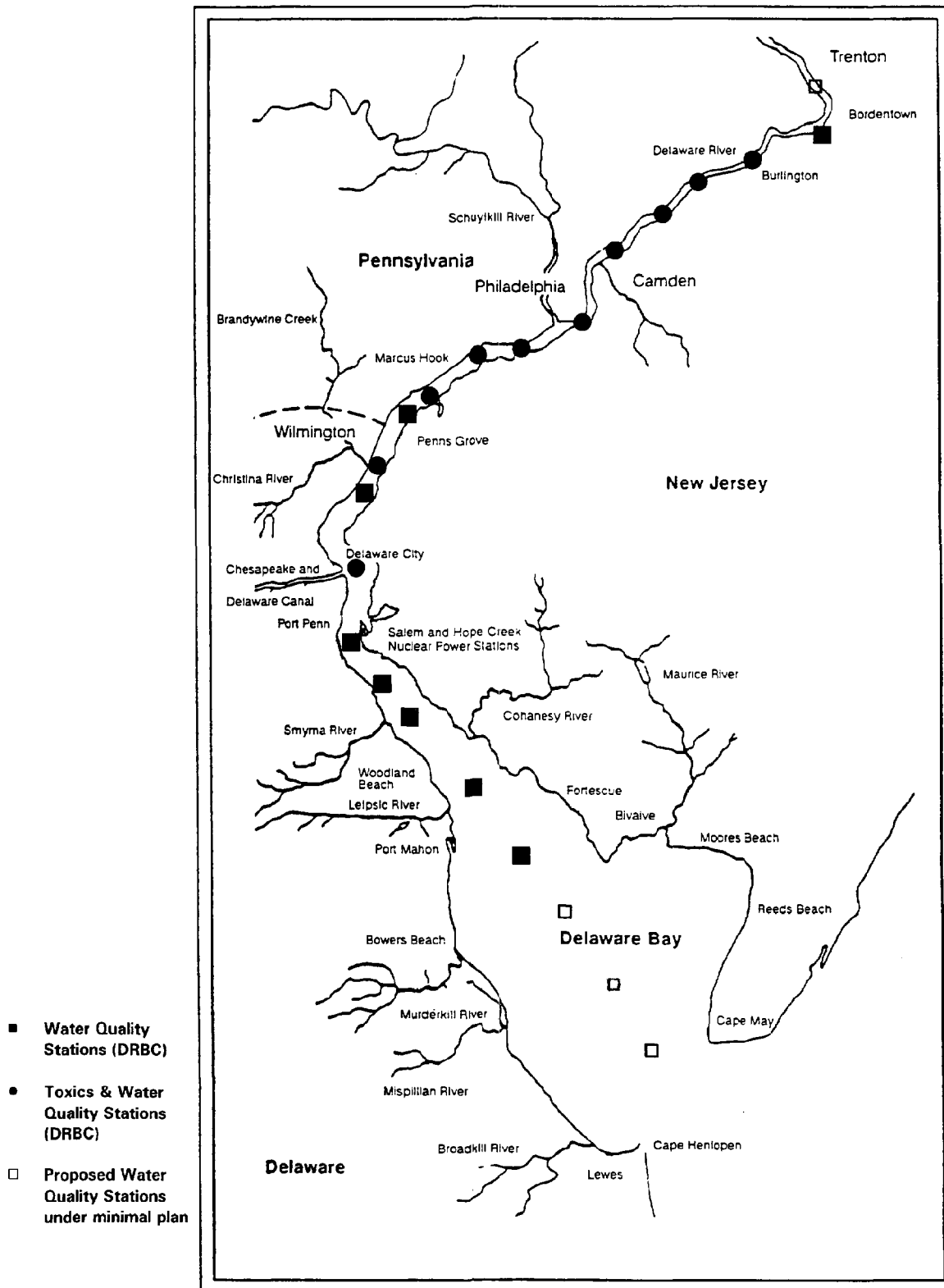


Figure 52. Water Quality and Toxics Monitoring Stations



Jersey and Delaware in the sub-tributaries of the Lower Estuary and shallow nearshore waters and 2) sampling by New Jersey and Pennsylvania in the sub-tributaries. Citizen monitoring on sub-tributaries is also considered an important component. USGS fall line monitoring of the Delaware River at Trenton and the Schuylkill River, in cooperation with state or local agencies, is essential for loadings estimates for these two major (over 70%) inputs to the Estuary.

EXPANDED PLAN

The expanded plan adds winter sampling (once monthly in December, January, and February) to the DRBC sampling program. This addition, which would require a larger ship plus additional analyses, would cost an additional \$75,000. The expanded plan also includes extensive use of satellite imagery for assessing changes in physical parameters (e.g., temperature, suspended sediment, and chlorophyll distributions) that impact water quality and living resources. The acquisition of data and computer analyses would cost approximately \$50,000 annually.

B. Toxics Monitoring

Toxics monitoring includes three separate media groups: water column, bottom sediments, and biotic tissue. In addition, some level of toxicity testing will be done in conjunction with sediment and tissue sampling.

MINIMAL PLAN

The minimal plan is a continuation of ongoing activities by DRBC, the states, NOAA, and FDA. Water column sampling for toxics is carried out by DRBC, in conjunction with the water quality sampling, at a subset of 10 stations (See Figure 52). Samples are analyzed for copper, lead, zinc, and volatile organics. DRBC also samples fish species for metals, chlorinated pesticides, and PCBs at five stations. In addition, the states perform toxics analyses of fish tissue to develop fish consumption advisories. The NOAA mussel watch program provides information on accumulation of toxics in shellfish, and occasional sampling of market fish by FDA also provides toxics information.

EXPANDED PLAN

The expanded monitoring plan would include water column toxicity testing, sediment sampling of the shallow nearshore areas of the Estuary, and sampling of fish and benthic organisms for toxics accumulation. Although sampling would not necessarily be a single complete annual survey, the cost on an annual basis for periodic (2 to 4 year intervals) sampling would be about \$110,000.

C. Living Resources Monitoring

The living resources monitoring plan is difficult to design because there has been limited routine monitoring of living resources previously in the Delaware Estuary and because it is difficult to link populations of living resources with results of management activities. However, several major ongoing activities and a number of small unrelated monitoring activities can be included in an overall comprehensive monitoring plan; in addition, a new large element is suggested. Combined, these activities could provide much information to evaluate the status and trends of living resources in the Estuary.

MINIMAL PLAN

The minimal monitoring plan would continue two ongoing monitoring activities: the New Jersey and Delaware trawl sampling for demersal fish (See Figure 53) and New Jersey beach seine sampling for fish. These two activities, supplemented with an intended new trawl program by PSE&G, should give adequate monitoring of demersal fish and fair, but not complete, sampling for pelagic fish. Information on harvests will supplement the fish monitoring. Monitoring of oyster populations, in Delaware and New Jersey, should continue and is sufficient at this time to monitor that resource. The volunteer beach survey of horseshoe crabs needs to continue but be redesigned. The survey, plus counts of horseshoe crabs from fish trawls, will give some information on populations of this resource. Ongoing sampling

OBJECTIVES: LIVING RESOURCES



Estimate relative abundance and trends of populations of living resources:

Harvestable fish and invertebrates

Bird populations

Amphibians, reptiles and mammals (selected estuarine-dependent reptiles and mammals as well as vernal pool amphibians)



Estimate overall ecosystem health in terms of production and diversity.

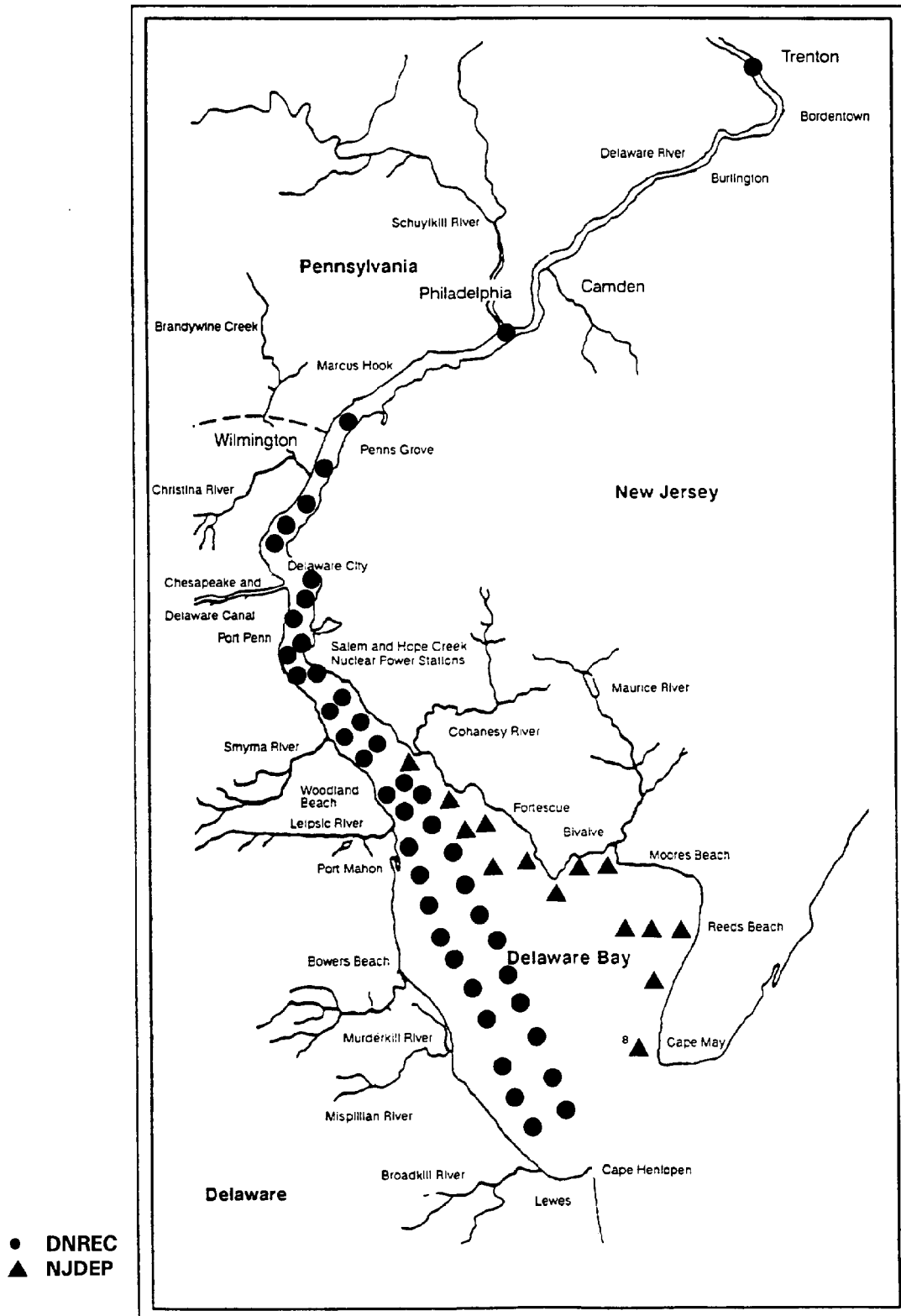


Figure 53. Existing Demersal Fish Survey Stations





activities for bird populations are good, but need a stable funding source and should be expanded. The Natural Heritage Inventory Program provides some information on amphibians in vernal pools and these surveys should continue. Ongoing sampling activities for reptiles, amphibians, birds, and mammals need to be more carefully examined and evaluated; at a minimum level, populations need to be monitored consistently.

A new benthic monitoring program is proposed to assess ecosystem health. This would consist of stratified random sampling at approximately 68 stations at 5-year intervals to characterize benthic assemblages (See Figure 54). This sampling could also provide material for the sediment and biota toxics analyses. The cost estimate for benthic macroinvertebrate monitoring is \$50,000 for a complete survey.

EXPANDED PLAN

Other new monitoring programs for ecologically important species may be proposed in the future, particularly as related to the "priority species" identified by the program.

D. Habitat/Land Cover/Land Use Monitoring

OBJECTIVES:	HABITAT/LAND COVER/LAND USE
	<p>Delineate land cover/land use as a baseline using appropriate classification schemes developed on a cooperative basis for specific purposes:</p> <ul style="list-style-type: none"> ⇒ Areal extent and distribution of plant communities and critical habitat for priority species ⇒ Growth and development ⇒ Population and economic trends
	<p>Document extent of fragmentation and connectivity of habitat, species composition, and substrate characteristics.</p>
	<p>Update delineation on a frequency of no more than five year intervals.</p>
	<p>Document changes in land use and land cover and analyze trends in:</p> <ul style="list-style-type: none"> ⇒ Critical habitat for priority species ⇒ Growth and development ⇒ Population and economic trends

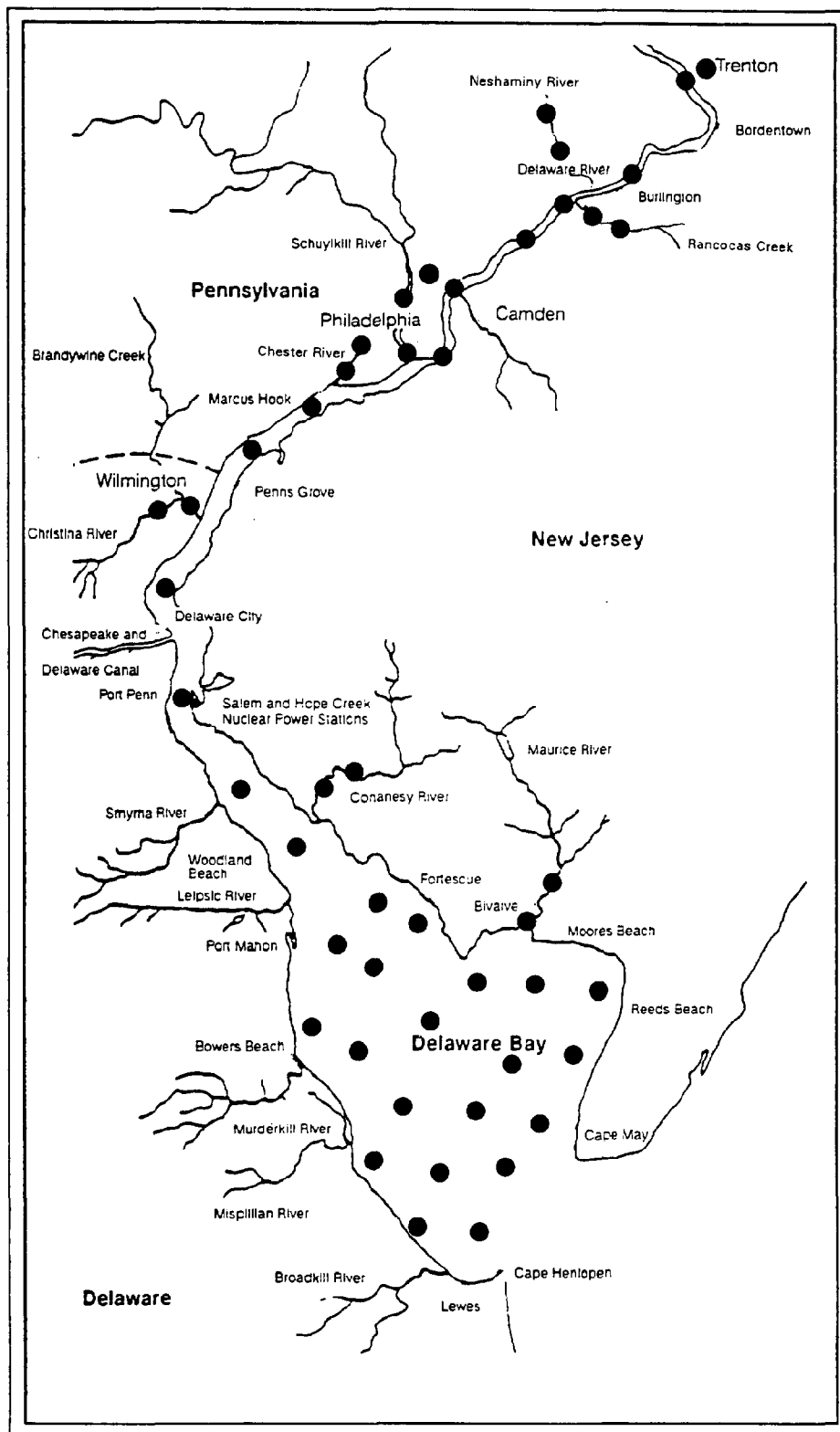


Figure 54. Benthic Monitoring Stations (Mod. after EMAP), 1991

Land cover is the primary focus for both habitat evaluation and land use determinations. The major monitoring tool to determine land cover is large area mapping. Areal photography and satellite imagery, supplemented by ground-truth sampling, are proposed.

MINIMAL PLAN

The proposed minimal plan for monitoring habitat/land cover/land use is to continue ongoing efforts. The cooperative National GAP Analysis Project (GAP) will give us a good picture of current land cover to examine habitats and see the impact of land use practices. Future similar mapping efforts at intervals not to exceed five years would provide the information necessary to assess changes. In addition, Delaware Valley Regional Planning Commission mapping is a necessary and distinct method for land use assessment. This mapping is possibly adequate for the Pennsylvania and New Jersey portions of the Estuary, but it should be expanded into Delaware as well. Information from the Coastal Zone Management Act, Nonpoint Pollution Control Program, also provides monitoring data.

EXPANDED PLAN

The extensive recent effort of New Jersey to map the entire state, using GIS format, provides a more detailed and very valuable land cover/habitat evaluation of the New Jersey portion of the Estuary. A similar project should be conducted in Pennsylvania and Delaware as part of the expanded plan. New Jersey's effort cost close to \$10 million over five or more years for the entire state; the proposed effort for Pennsylvania and Delaware is therefore estimated to cost several million dollars over a period of years. In addition, a small grants program should be developed through the Delaware Estuary Foundation to fund citizen groups to collect observational data on habitat and land use. This program would cost about \$50,000 annually.



Recommendations

The following activities are recommended to implement the monitoring plan.

ACTION M1: Establish an Interim Monitoring Advisory Group

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M1: Interim Monitoring Advisory Group	<i>Lead:</i> Delaware Estuary Program	Short-term	No new resources

What and How: Starting in January 1995, an interim advisory group will be established to prepare for implementation of the monitoring plan. Membership of this group should include representatives from state and federal agencies, academic institutions, industry, and the general public. The group will be responsible for the final design of the monitoring plan and will have a central role in obtaining commitments from the parties involved in implementing the monitoring plan.

Measure of Success: Interim monitoring committee established.

ACTION M2: Establish a Permanent Monitoring Advisory Committee

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M2: Permanent Monitoring Advisory Committee	<i>Lead:</i> Delaware Estuary Council	Short-term	See M3

What and How: By January 1996, a permanent Monitoring Advisory Committee should be established by the Delaware Estuary Council. Members representing a designated list of agencies and organizations would be formally appointed, based on suggestions from the interim Monitoring Advisory Group. The Monitoring Advisory Committee should guide the Cooperative Monitoring and Mapping Program. This Committee should report to the Estuary Council.

MONITORING

Measure of Success: Permanent monitoring advisory committee established.

ACTION M3: *Establish the Office of Monitoring and Mapping Coordination*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M3: Office of Monitoring and Mapping Coordination	<i>Lead:</i> Delaware Estuary Foundation	Short-term	\$100,000 annually, for salary of Coordinator and operation of office

What and How: By January 1996, a monitoring office should be established, supported by a full time Monitoring Coordinator who would work closely with the Monitoring Advisory Committee. The Coordinator would work with the staff of the Regional Information Management Service (RIMS — See Chapter IX), so that monitoring data received are made rapidly available to all interested users. In the first two years, the Coordinator would focus on coordination of monitoring activities within various agencies and quick acquisition of the data from these activities. A major task would be to ensure that compatible and consistent analytical quality assured measurements are made by the various participating agencies. By the third year, the Coordinator's activities would shift toward evaluation and interpretation of the monitoring information. Both the coordination and evaluation of monitoring data would be carried out in close coordination with the Monitoring Advisory Committee.

Measure of Success: Monitoring coordinator established and funded.



ACTION M4: *Implement the Minimal Monitoring Program*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M4: Minimal Monitoring Program	<i>Lead:</i> Delaware Estuary Foundation	Short-term	Continue ongoing agency programs (at approximately \$3 million annually); \$250,000 new funding

What and How: The minimal monitoring program should incorporate existing monitoring activities, with modifications, as defined in the Delaware Estuary Cooperative Monitoring Report. It is based on collection and evaluation of data by existing agencies and proposes no new independent data collection and analyses activities. The Monitoring Advisory Committee should develop Memoranda of Understanding (MOUs) with the participating agencies to implement the minimal monitoring program.

Measure of Success: Program funded and implemented.

ACTION M5: *Implement the Expanded Monitoring Program*

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M5: Expanded Monitoring Program	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	\$900,000 per monitoring cycle (to be further analyzed)

What and How: The expanded monitoring plan should include the items specified in the Delaware Estuary Cooperative Monitoring Report.

Measure of Success: Funding secured and expanded plan implemented.

ACTION M6: Evaluate and Report Monitoring Information

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION M6: Monitoring Report	<i>Lead:</i> Delaware Estuary Foundation	Mid-term	Included in M3

What and How: For either the minimal or expanded monitoring plan, there should be regular evaluation of the information derived from synthesis of the monitoring data. An annual summary of the monitoring data in the RIMS would be prepared. Every three to five years (to coincide with timing of CCMP action plans), a more complete report of the annual monitoring information would be produced, with an assessment of status and trends. New preliminary findings would be distributed in Delaware Estuary newsletters as quickly as possible, even prior to annual reports.

Measure of Success: Annual monitoring reports prepared.



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CHAPTER IX: Regional Information Management Services Action Plan

Current data management practices are fragmented across the Delaware Estuary, reflecting numerous geographical, political, and organizational divisions of environmental responsibility. Those who seek information outside their regulatory channels of communication may succeed, if sufficiently persistent, but typically face a difficult task involving numerous telephone calls, referrals, and false leads. If data are obtained, questions about comparability and quality assurance may become hurdles to data use. On the other hand, data providers may be overwhelmed by the sheer number of ill-informed callers searching for data and therefore be unable to respond efficiently. It is likely that much of the environmental data presently collected in the Estuary is under-utilized due to lack of convenient access, especially the data collected by industrial dischargers or land developers. Effective management of the Delaware Estuary in the post-CCMP period will increasingly require timely data access by all managers, from municipalities and county governments to state and federal agencies.

To address this need for coordination and access, the Delaware Estuary Program Data Management Committee has prepared a Regional Information Management Service, or RIMS concept. RIMS is a plan designed to address the needs of Estuary managers and other users and providers of environmental data by facilitating use of existing data sets. (More detailed information about RIMS can be found in a companion document to this Plan). Surveys and workshops conducted by the Committee revealed that users need better tools to locate information, especially when data sources span agency or institutional boundaries. To aid in the location of such information, RIMS will employ 1) an electronic index describing data sets and data providers, 2) a knowledgeable data manager who will maintain the data index and respond to questions, and 3) an electronic bulletin board for data requests and other messages, and for transmission of data in some cases. Access to data across the Estuary will be enhanced with toll-free long distance phones and Internet connectivity.

Another perceived need of users was better access in terms of quality (more user-friendly) and quantity (Internet connectivity and toll-free modem lines) to on-line data systems, such as the Ocean Data Evaluation System (ODES) and STORET, both USEPA sponsored environmental data bases. Other groups are working on this problem; if they succeed, then little additional action may be needed through RIMS.

The model for RIMS is illustrated in Figure 55. The Data Depot, shown in the diagram, will not be a part of the pilot project described in Action R1, but could potentially be a component of the long term RIMS project. The function of the Data Depot would be to reduce the workload of data providers for frequently requested data. The data provider could opt to supply the data manager with electronic or hard copies of such data sets so that the data manager could distribute them directly.

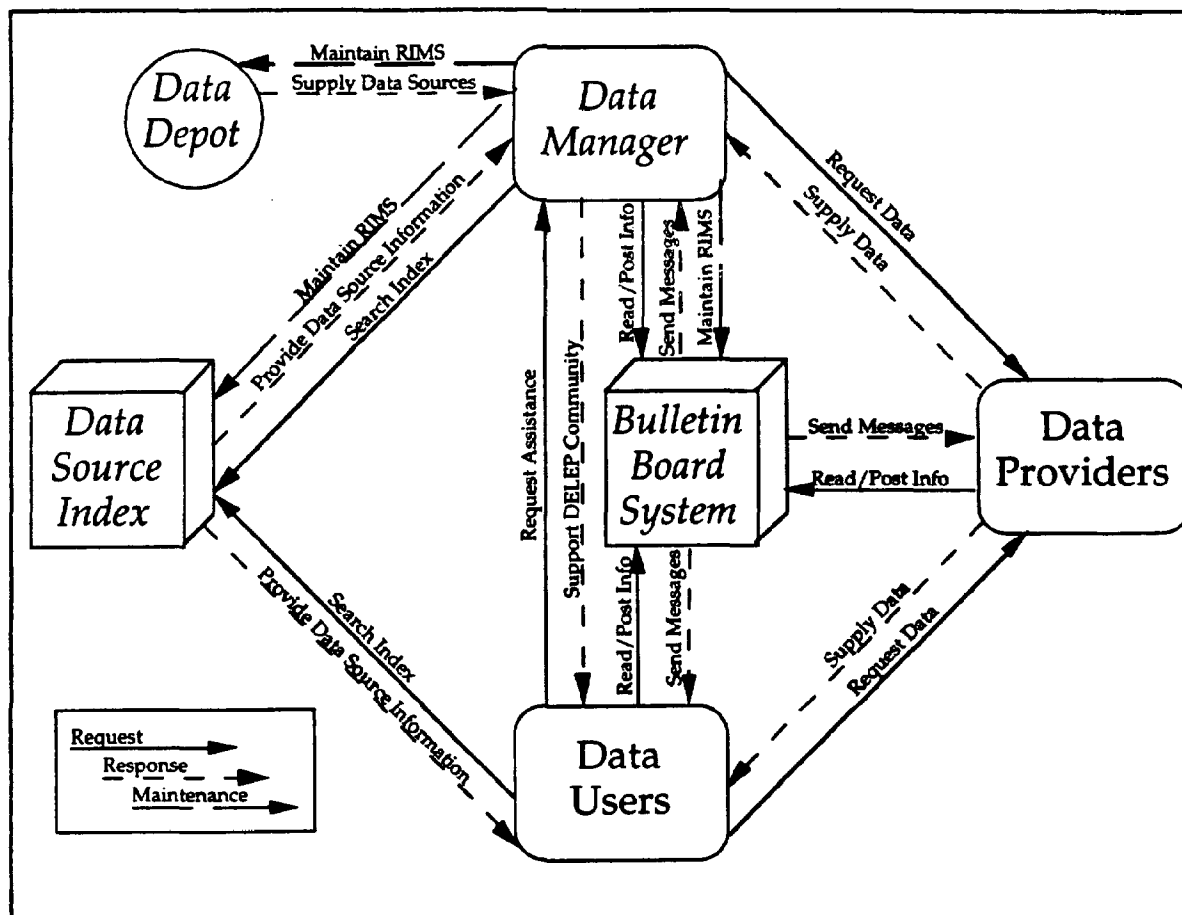


Figure 55. RIMS Conceptual Model

Recommendations

The following items are recommended in order to implement the RIMS concept:

ACTION	RESPONSIBLE ENTITIES	DATE	RESOURCE NEEDS
ACTION R1: Pilot RIMS	<i>Lead:</i> DRBC	Initiated November 1994	\$46,000 and DRBC resources
ACTION R2: Expanded RIMS	<i>Lead:</i> Delaware Estuary Foundation will determine after evaluation of pilot project	Initiate September 1995	*See below

ACTION R1: <i>Implement RIMS on a Pilot Scale for One Year</i>

Why: For all the reasons cited above, RIMS would be an asset to the management of the Delaware Estuary. However, because of the substantial cost of implementing the Service, a pilot scale project will be carried out and an evaluation will be made as to the future scope of RIMS.

What and How: RIMS is currently being tested as a one year pilot scale project through a matched grant to DRBC. Software and hardware will be acquired or developed to set up the bulletin board service, create the data source index, and provide "800" phone access. DRBC will hire a part-time data manager and provide a part-time system operator to set up the system, operate it, and evaluate its effectiveness in coordination with the DELEP Data Management Committee. This evaluation, along with the availability of future funding, will determine how RIMS will be implemented in the long term.

It is expected that the pilot RIMS will be on-line in early 1995. The DRBC data manager can be contacted at the West Trenton, New Jersey office at 609-883-9500 to inquire about access to the Service.

Measure of Success: Implementation of the pilot project, including remote access to bulletin board service and the data source index, a data manager who is able to assist users in obtaining access to data, and an overall increase in access to environmental data and information. The final measure of success will be the completion of the evaluation of the overall project with recommendations for future RIMS development.



ACTION R2: *Implement RIMS in Expanded Form*

Why: As previously mentioned in this chapter, it is frequently very difficult to find out about, and then access, environmental data and information from the various agencies and organizations throughout the Estuary area. RIMS should help solve this problem by providing information about the data and facilitating access to the data.

What and How: Based on an analysis of the pilot scale RIMS, RIMS should be implemented in an expanded form with options to grow as dictated by user needs and available funds. According to the data management report (a companion document to this Plan), the most cost effective platform for full service RIMS is a UNIX workstation with the number of modem and Internet ports scaled to anticipated demand. A full-time manager will be needed to expand and maintain the data index and to assist the data community.

***Resource Needs:** If a full-scale RIMS is implemented as suggested in the data management report, the initial setup cost would be \$220,000, with an annual maintenance cost of \$120,000. These estimates assume that the cost of housing RIMS will be borne by the partner.

Measure of Success: Increased access to data and information is the objective of this action, which can be quantified by the number of inquiries to RIMS and the amount of data that is shared. The long term measure of success is broader acceptance and use of the available data to support management decisions.

CHAPTER X: The Unfinished Agenda

In the early days of the Delaware Estuary Program, Management Conference members recognized that scientific and policy issues would emerge, both during the characterization phase and the development of CCMP action plans, that would need to be addressed beyond the six year period required to develop this CCMP. It was also anticipated that unaddressed issues would be identified during the CCMP public review process. The purpose of this Unfinished Agenda is to document and explain these remaining issues, which will continue to be addressed by the Delaware Estuary Council or Foundation after the publication of this first comprehensive Plan.

Significant gaps have been identified by the Management Conference in our scientific understanding of the Estuary and its response to environmental stressors. We lack information on certain basic estuarine processes as well as the cumulative environmental effects of pollutant loadings on these processes. We recognize that continuing research is needed to provide better information on the status of currently identified problems, so that the benefits of corrective actions can be measured, or new actions proposed. And, finally, needs for additional research and policy initiatives emerged over this last year, as we evaluated the likely cumulative result of the actions in this Plan.

As we work collectively toward our vision of the Delaware Estuary, we will continue to address the following issues:

Significant gaps have been identified by the Management Conference in our scientific understanding of the Estuary and its response to environmental stressors.

A. Land and Water Use



INNOVATIVE STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Many of the Land Management actions (Chapter III) address the need to better coordinate land use planning efforts and utilize techniques such as Transfer of Development Rights (TDRs) and cluster zoning to protect the Estuary's valuable natural resources. However, the Delaware Estuary Program recognizes that these techniques, even when used in conjunction with regulatory programs, cannot guarantee that land will be developed or protected in a sustainable and equitable manner.



Land owners face many pressures in their decisions on HOW or IF their land will be developed. Land is typically valued for its "highest and best use" — which is usually development (i.e., buildings, malls, industry, subdivisions). There are no current economic standards by which to monetarily value land for its natural resource potential. If land is rendered undevelopable, it has little or no economic value to the owner and generates very little tax revenue for the host municipality. From a local government perspective, this current system is forcing communities to compete in attracting more sources of property tax revenues. This is known as the "ratable chase", where local governments try to attract more people and businesses to sustain schools and infrastructure.

The issue of how to protect natural resource-rich areas without denying land owners economic use of their lands or negatively affecting the economic stability of a community should be addressed. The Delaware Estuary Council should continue to explore new ideas and sustainable alternatives for protecting the Estuary's resources, while maintaining the economic viability of the region. Innovative tools, techniques, and strategies need to be formulated and pursued.



IMPACTS OF WATER USE

Growth and development have resulted in increased demands on surface and groundwater. We currently do not understand the incremental and cumulative impact of water use in the Estuary sufficiently well to implement preventative regulatory measures. Surface water withdrawal and discharge along the Estuary can have subtle, but significant, impacts on estuarine resources, ranging from entrainment to toxicity and thermal effects. Overdrafts of regional groundwater aquifers can result in salt water intrusion to deeper levels. Groundwater transport of pollutants to the Estuary through recharge is also poorly understood. Research is crucial to enable regulators to address the potential cumulative impacts of water uses on the hydrological cycle and estuarine resources. Results would provide guidance in the development of a regional environmental policy plan.



A BASINWIDE POLICY ON CO-GENERATION PLANTS?

Various stakeholders have advocated the need for a basin-wide policy on co-generation plants, because of the individual and cumulative environmental impacts that could potentially result

from the large number of plants planned for the region. This concern is part of a broader question related to the cumulative impacts of water withdrawal, discussed above. Potential needs include additional information as well as regulatory changes, such as uniform and consistent standards for plant siting throughout the Estuary region and the formulation of clear standards to determine impacts from generating stations.

AN ESTUARY-WIDE ANTI-DEGRADATION POLICY?

The anti-degradation policy authorized by the Clean Water Act requires each state to develop and implement a program that maintains existing instream water uses by maintaining the level of water quality necessary to protect those uses. Each state's water quality standards must include minimum elements to ensure water quality is not lowered or degraded. The Delaware Estuary Council should explore the need for a watershed-wide anti-degradation policy and implementation procedures. The development of watershed-wide implementation procedures would require that the three states agree to an approach to ensure consistent protection throughout the Basin. Such an approach could initially focus on those substances on the Preliminary List of Toxic Pollutants of Concern (see Chapter VI).

B. Habitat and Living Resources

BIOLOGICAL MONITORING AND ESTUARY-SPECIFIC CRITERIA

Biological monitoring is integral to the measurement of the total ecological health of a waterbody and has become increasingly important in regulatory agency programs. An estuarine community bioassessment protocol should be developed, to support cost-effective biological monitoring. This protocol should be easily interpreted and understood by water quality managers and planners.

Living resources respond not only to water quality perturbations, but habitat destruction as well. Ecological integrity is therefore measured using a variety of parameters, some of which are sensitive to habitat degradation in the specific geographic regions for which they were developed.

Development of Delaware Estuary-specific biological criteria could serve a variety of purposes, including the characterization of regional biological components, documentation of the existence



and severity of use impairments, support for use attainability studies, and evaluation of the effectiveness of control strategies.

Future monitoring of the Estuary should also include more emphasis on biological resources from an ecosystem health perspective. Research is needed to provide us with proper tools, including biomarkers for this type of assessment.



KNOWLEDGE OF EXTERNAL INFLUENCES ON LIVING RESOURCES

Effective living resource management plans for Delaware Estuary species must be developed with consideration of external influences on specific populations. Data should be generated on the impacts of activities taking place beyond the boundaries of the Delaware Estuary. One example of this is the effect of North Carolina shrimp fishery by-catch on the coastal weakfish stocks that spawn in the lower Delaware Bay. Another example is the impact of the loss of South American rain forest habitat on those neotropical bird migrants that have summer breeding habitat in the Delaware region. These external influences must be known in order to develop successful species management plans.



OYSTER DISEASE RESEARCH

Oyster stocks in the Estuary have been decimated by disease. In the late 1950s, and again in 1985, the protozoan parasite MSX ("multi-nucleated sphere unknown") devastated the stocks. Periodic climatic conditions that lowered salinities and suppressed MSX, and the development by natural selection of strains resistant to the parasite, sustained the oyster industry until recently. However, in the 1990s, the parasite Perkinsus Marinus, the cause of Dermo disease, invaded the Estuary. This parasite was most likely introduced through oysters imported from the Chesapeake Bay and from the discharge of wastes from plants processing oysters in areas where Dermo disease is prolific. MSX-resistant oyster strains are unfortunately not resistant to Dermo. Support for research to develop a strain of oysters resistant to both diseases is needed to ensure the future of the oyster and oyster industry in the Delaware Estuary.

C. Toxic Substances

SEDIMENT CRITERIA

Currently there are only a few sediment criteria for toxic substances. Additional criteria must be developed for those substances, identified in the DELEP list of toxics of concern, that are associated with sediments, as well as others as they are identified.

Data on the acute and chronic toxic effects of contaminated sediments on the biota, especially benthic communities, of the Estuary need to be evaluated and augmented as necessary.

The effects of the resuspension of contaminated sediments, resulting from dredging activities and high river flows, need further evaluation.

TISSUE CONCENTRATIONS OF TOXIC SUBSTANCES IN CERTAIN FISH SPECIES

Information is needed on the tissue concentrations of toxic substances in fish species that are not currently monitored. Shad, for example, has a very high lipid (fat) content and has the potential to accumulate high levels of certain contaminants that are attracted to fatty substances. Human health risk assessments for consumption of these species should be performed. Further characterization of toxic substances in lower trophic levels and subsequent transfer through the food chain is also needed.

D. Monitoring

AMBIENT ESTUARINE MONITORING

Extensive effluent monitoring for water quality compliance is performed by industrial and municipal dischargers in the tidal river. The vast majority of monitoring samples show no violations of standards and, often, measured parameters are below limits of detection. This monitoring provides little information other than legal compliance. Ambient estuarine monitoring, on the other hand, has been more modest and hindered by the lack of financial support. It would be valuable to reduce the intensity of compliance monitoring and cooperatively increase ambient status and trends monitoring. There are, however, serious legal impediments to any reduction in compliance monitoring.



Information is needed on how such impediments can be overcome, to continue to provide maximum environmental protection through compliance, and yet redirect financial support for more effective and comprehensive integrated monitoring.

E. Potential Environmental Problems



BIOLOGICAL RESPONSE TO CERTAIN POLLUTANTS

As pointed out in Chapter II, the Delaware Estuary has one of the highest concentrations of nutrients of any major estuary in the country. Major sources of these nutrients are municipal discharges in the urban tidal freshwater zone. Elevated nutrient concentrations usually result in massive blue-green algal blooms in freshwater. However, levels of algal and bacterial production are suppressed in the riverine portion of the Estuary, and a study of factors that could limit production provided no clear answer as to whether or not organic or trace metal toxicity is limiting this growth. The waters of the Bay have not exhibited the mahogany and brown tides that are characteristic responses to nutrient inputs in higher salinities. There are some preliminary indications that the nutrients from the Estuary are being translocated to near shore coastal ocean waters where increases in algae are noted. Information is needed on the basic estuarine processes which control algal and bacterial productivity.

The actions proposed in this CCMP have the potential to reduce toxicity, especially in the urban area, and may remove the apparent block to algal growth. It is important that research and monitoring be targeted to define ecosystem responses to these strategies, and determine whether future management strategies for nutrient removal may be warranted. Uncertainty about the biological response to pollutants clearly limits the ability of regulatory agencies to predict the environmental benefits of management controls or to determine the need for additional controls.

F. Other Issues of Concern



OUTREACH TO UPPER WATERSHED

Currently the geographic scope of the Delaware Estuary Program includes the mainstem and tributaries of the Delaware Estuary to the head of tide. Since its inception, the Program has recognized the potential for impacts to the Estuary from activities in the upper

non-tidal portion of the watershed. Concerns continue to be expressed about ecosystem resource threats from upstream changing land uses, and suburbanization and farming along the river, that may be contributing to nonpoint source pollution to the Estuary. Information from citizens monitoring and other programs should be analyzed to determine the magnitude of these potential problems.

The Delaware Estuary Foundation should develop and implement an outreach strategy that fosters interaction and information sharing with citizen groups, local governments, and agencies in the upper watershed. The potential exists for the Foundation to build partnerships with public and private entities that can result in the endorsement and implementation of a watershed-wide protection approach.



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CHAPTER XI: Implementing the CCMP

The Delaware Estuary Program findings establish a clear basis for long-term regional management that focuses on the region's land, water, and living resources as a watershed ecosystem. The Program also seeks to achieve sustainable development by guiding economic growth of the region in accordance with the goal of restoring and protecting the living resources of the Estuary. This presents a significant challenge not only because it requires reshaping the relationship between economics and the environment in the region but also because the 6000 square mile area that comprises the Delaware Estuary watershed spans two regions of the Environmental Protection Agency, three states, 22 counties, and over 500 municipalities — not to mention a broad array of private stakeholder interests.

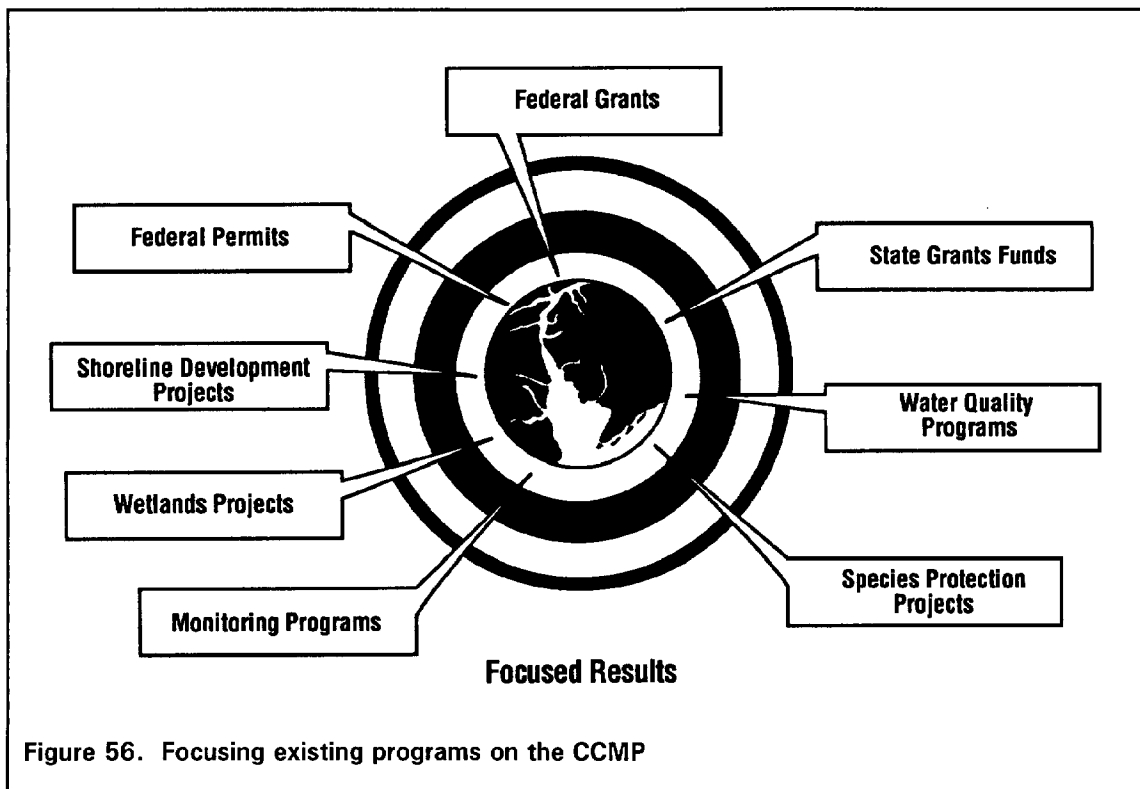
The Delaware Estuary Program, through its broad participation network and concerted effort to develop partnerships, is well positioned to meet this challenge. By focusing attention on areas of common interest and identifying opportunities to collaborate and efficiently allocate responsibility, the Program has laid the groundwork for an additional level of incremental environmental improvements based on using non-regulatory "civic" tools, such as economic incentives, technical assistance, and education, along with regulatory policies.

This Plan represents an opportunity to build on the success of the past by adopting a new approach to environmental protection. This approach recognizes that government agencies alone cannot achieve sustained environmental improvements. The cumulative effects of the day-to-day decisions made by millions of people who live, work, and play in the Delaware Estuary watershed can greatly outweigh the environmental benefits of a particular governmental program. We must change the way we think and operate individually and collectively. In addition, instead of simply controlling problems or mitigating the impacts of our actions on the environment, we must work to avoid the problems from the start. Actions included in this Plan recognize that each stakeholder and interest group in the watershed, as well as all levels of government, have an opportunity and an obligation to contribute to identified solutions.

The Program has laid the groundwork for an additional level of incremental environmental improvements based on using non-regulatory "civic" tools, along with traditional regulatory policies.

A. Implementation Strategy

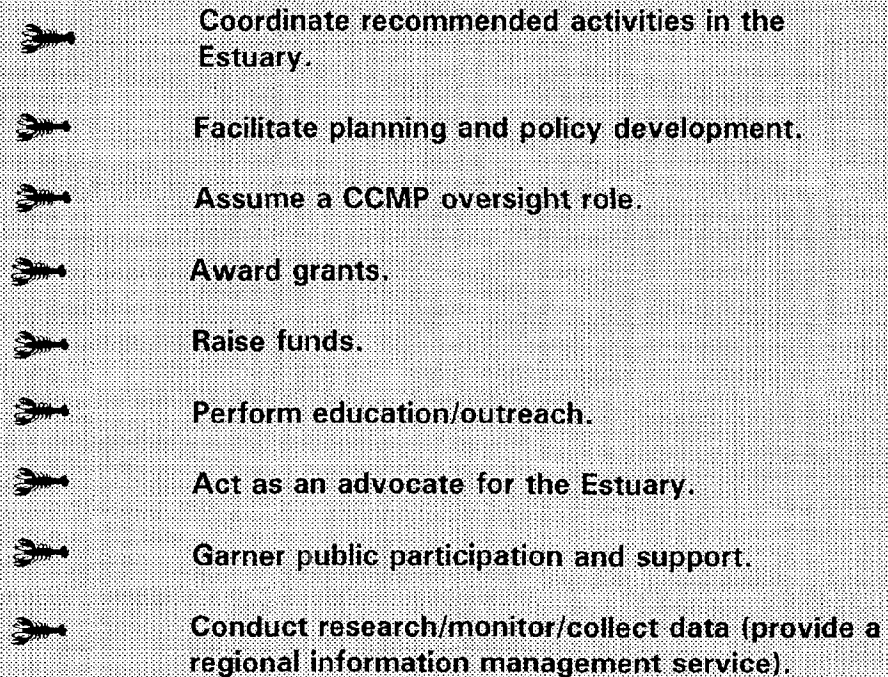









Congress, in crafting the National Estuary Program as part of the Clean Water Act, clearly contemplated that the five year investment in local consensus building and planning for wise conservation and management of estuaries would yield decades of dividends in the form of efficient, integrated action to solve regional problems. "Action" in this context encompasses not only the specific initiatives outlined in this Plan, but also the creation of processes and mechanisms for continued problem solving, deliberation of region-shaping issues, and funding for public interest projects consistent with the goals and objectives of the Plan. Figure 56 represents examples of existing environmental programs that the Delaware Estuary Program will focus toward achieving the goals and objectives of the Plan.



As part of its charge to develop an implementation strategy for the CCMP, the Program retained the services of a management consultant, in 1992, to examine institutional structures that could serve as models for the Program and to review actual institutions currently operating in this capacity in other estuary-related programs around the country. The Program also established an

Implementation Task Force, in 1993, to further evaluate implementation options. These efforts resulted in a determination that the ultimate organizational structure must be able to perform nine functions:

These functions were then used to evaluate three organizational models: charity, trust, and management conference. This involved explicit consideration of the role existing agencies could play in performing specific functions. For example, the Management Conference must rely on a second entity to act on its behalf in accepting federal grant funds

- 
-  **Coordinate recommended activities in the Estuary.**
 -  **Facilitate planning and policy development.**
 -  **Assume a CCMP oversight role.**
 -  **Award grants.**
 -  **Raise funds.**
 -  **Perform education/outreach.**
 -  **Act as an advocate for the Estuary.**
 -  **Garner public participation and support.**
 -  **Conduct research/monitor/collect data (provide a regional information management service).**

or contracting for work or services, as the Conference is not a legal entity and is not eligible to receive grant funds earmarked for the National Estuary Program directly. DRBC currently serves in this capacity as the Program's fiscal agent, accepting and disbursing federal grants and other funds at the direction of the Management Committee.

The consultant identified four possible institutional arrangements that could comprise a final organizational structure to facilitate financing and management of the implementation of the CCMP:






1. One or more public charities.
2. The Management Conference.
3. DRBC or an alternative existing agency.
4. An interstate trust.

The final report recommended that the Delaware Estuary Program establish two public charities, one which is governed by the



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Management Conference. By establishing two charities, the Conference is likely to:

-  Maximize access to potential revenues.
-  Maximize coordination of Estuary planning efforts, funding, and implementation activities.
-  Provide a vehicle to garner direct public participation and support for the Estuary Program.
-  Create an institution that can conduct independent oversight of CCMP implementation.
-  Protect the broad representation of the Management Conference in the event it is not continued by Congress.

Based on this analysis, the Management and Policy Committees reached agreement that the post-CCMP Management Conference should include three major components: 1) a Delaware Estuary Foundation; 2) a Delaware Estuary Council; and 3) an Estuary Advisory Committee.

B. Implementation Structure

One of the most significant actions proposed in this Plan is to continue the Management Conference by creating a new non-profit corporation, by restructuring the existing voluntary partnership among agencies and Estuary stakeholders, and by consolidating the Program advisory committee structure (See Figure 57 which depicts a proposed organizational structure). Both a Foundation and Council are necessary because government officials cannot sit on a non-profit corporation.

THE DELAWARE ESTUARY FOUNDATION

The main purpose of this group would be to support implementation of the Delaware Estuary Comprehensive Conservation and Management Plan. In this capacity, the Foundation would act as an advocate for the Estuary and attempt to achieve focused results by steering public and private resources toward specific management actions. This would be accomplished by periodic coordination with the Delaware Estuary

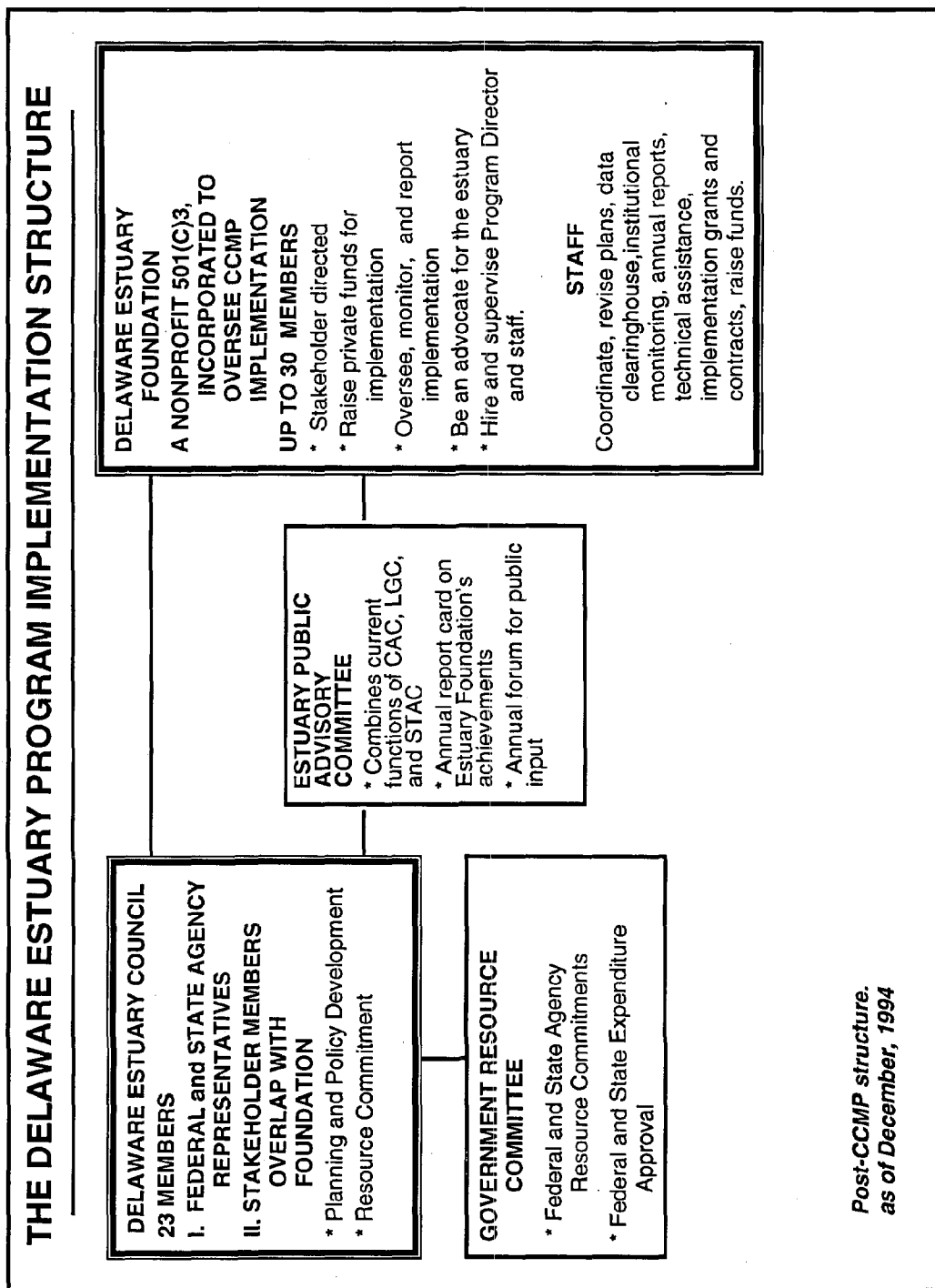


Figure 57. Implementation Structure



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Council, described below, and through raising, accepting, and disbursing funds for activities that would lead to the restoration and enhancement of the Delaware Estuary.

To accomplish the goals and objectives embodied in the Plan, the Foundation would:

1. Assume an oversight role by tracking implementation, monitoring environmental trends and environmental/ecological threats, identifying research and monitoring needs, and highlighting conservation and management opportunities and barriers.
2. Serve as an independent fundraising vehicle that can accept federal and state funds and attract research, planning, and implementation funds from private foundations, industry, and individuals.
3. Provide funding and incentives to protect and enhance the Estuary.
4. Facilitate exchange of ideas and information through development of an Estuary-wide information clearinghouse.
5. Initiate action to address future issues of import to the Estuary.
6. Update the CCMP on a periodic basis in coordination with the Council.
7. Promote increased understanding and appreciation of the Delaware Estuary and its tributaries.
8. Promote conservation of the natural resources of the Estuary and its tributaries.
9. Contribute to the usefulness of the Estuary and its tributaries for recreational and commercial purposes that are compatible with sustainable use of estuarine resources.
10. Sponsor activities and events that contribute to the general welfare of the Estuary and its tributaries.

A small staff would report to the Foundation. They would be responsible for the day-to-day operation of the non-profit corporation, including arranging meetings, preparing annual

reports, raising and disbursing implementation funds, conducting public outreach, managing information for public consumption, and other related activities. They would also formulate workplans and develop budgets in collaboration with the Delaware Estuary Council.

THE DELAWARE ESTUARY COUNCIL

The main purpose of this group would be to facilitate collaboration, among public and private stakeholders of the Estuary watershed, in directing action and committing resources to the long-term health and vitality of the region. In effect, it would be a reconstituted Management Conference—a continuing voluntary partnership among federal agencies, the three states, and Estuary stakeholders—responsible for program implementation and development. In this capacity it would focus on planning, development of policy, coordination of existing regulatory authority, and advising the Foundation. The Government Resource Committee would make coordinated decisions concerning federal and state agency resource commitments.

The Council would act as an important vehicle for implementation by:

1. Allocating agency resources to implementation tasks.
2. Developing Memoranda of Understanding with the responsible federal and state agencies, to include coordination opportunities and procedures for establishing priorities, commitments, budget, and staff.
3. Proposing and implementing solutions to major Estuary problems, including but not limited to those authorized by state and federal legislation.
4. Encouraging corporations, citizen activists, and grass roots organizations by providing not only a vision and framework for action but also a clear idea of what these groups could do to contribute to protection and enhancement of the Estuary.

ESTUARY ADVISORY COMMITTEE

One of the significant accomplishments of the Program to date is the establishment of a broad network of expertise and interest in the health of the Estuary. This Committee would maintain that









network and draw from it, as appropriate, in the establishment of "Implementation Teams."

Collectively, the Foundation, the Council, and the Estuary Advisory Committee would act as advocates for the Estuary and as vehicles for monitoring progress in achieving Program goals and objectives.

IMPLEMENTATION TEAMS

The CCMP calls for development of Implementation Teams to implement specific actions, to develop remediation strategies, to further define problems, and other appropriate activities. It is contemplated that the Council and the Foundation would define the mission and membership of such teams and that they would operate for specific periods of time.

The Estuary Program as embodied in the Council/Foundation would operate as follows:

-  Each year, the Foundation Program Director would prepare a draft Delaware Estuary Program work plan and budget based on input from the Foundation Board of Directors, the Council representatives, and the Estuary Advisory Committee.
-  The draft Estuary Program work plan and budget would be circulated for review and comment to both the Council and Foundation members. This would trigger a Council meeting, the purpose of which would be to reach agreement on tasks, the prioritization of tasks, and, perhaps of most import, to identify tasks to be implemented directly with agency resources and those tasks best overseen and administered by the Foundation.
-  The Foundation, based on review and comment by the Council—including decisions concerning federal and state agency resource commitments for a given year—would then develop the Foundation work plan and budget and draft Programmatic Agreements as appropriate.
-  Foundation staff would be responsible for executing the work plan and negotiating the programmatic agreements.
-  Typical tasks to be performed by the Foundation staff include: day-to-day operation of the non-profit corporation; raising and disbursing implementation funds; conducting public outreach; coordinating monitoring and information management; administering the mini-grant program; securing public/private commitments to implement the Plan; and programmatic monitoring, including preparation of progress reports, evaluations, and Plan updates.
-  Typical tasks to be performed by the agencies based on direction from governmental Council members would be to: implement specific actions; participate on implementation teams created to craft innovative solutions and management schemes for specific problems; and allocate federal assistance program grants and loans to projects consistent with the goals and objectives of the Program.









C. Financing the Delaware Estuary Plan

The National Estuary Program provides funding for the development of CCMPs under Section 320 of the Clean Water Act, but it does not provide funding for the implementation of the plans. Without a strategy for funding the implementation of its CCMP, the Delaware Estuary Program runs the risk of turning this Plan into a shelf document instead of a guide to managing the natural resources of the Delaware Estuary.

The Program decided very early in its deliberations not to propose new general taxes, such as a gas tax, that would be dedicated to the implementation of the Delaware Estuary CCMP. In recognition of the substantial public interest in the Estuary, the Program decided to support implementation through a combination of donations, appropriations, and the focusing of existing resources. In focusing existing resources, the Program does not intend to diminish the funding of any existing program, but rather to focus the available financial and human resources on fulfilling the requirements of priority programs of the Delaware Estuary.

The program decided not to propose new general taxes.

This chapter proposes a multi-component financial strategy, including:

-  Creation of the Delaware Estuary Foundation, as described above, which could play a significant role in attracting and receiving funds, such as public grants and contracts, corporate donations, and membership fees;
-  Effective use of current state and federal programs;
-  Steering local and regional private foundation grants to Estuary Program initiatives;
-  Development of public/private partnerships;
-  Establishment of Estuary Program license plates in each of the states;
-  Exploring fees for selected services;
-  Support for federal legislation; and
-  Seeking specific allocations of economic development funds from regional authorities.

Costs associated with the Plan are of two types: maintaining the Delaware Estuary Program (in its reconstituted form as the



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Delaware Estuary Foundation and the Delaware Estuary Council); and implementing the actions in the Plan. Each of these is more fully explained in Appendix G.

FUNDING THE DELAWARE ESTUARY COUNCIL

For the first three years, it is estimated that the Program will receive \$300,000 from USEPA under Section 320 of the Clean Water Act. These funds are designated for administering CCMP implementation and will be available from October 1995 to September 1998. These funds require a 25 percent non-federal match which should be provided by the States of Delaware, Pennsylvania, and New Jersey. Additional sources of revenue, as detailed below, are expected to generate an additional \$300,000 to \$500,000 per year. This will give the Foundation an annual operating budget of \$600,000 to \$800,000. As indicated in Chapter IV, the metropolitan port complex is ranked second in the Nation in total waterborne commerce, generating an annual income of over \$3 billion and 180,000 jobs. In this context, the proposed Foundation operating budget represents a .03 percent additional investment in the improved health of the Estuary.

The Foundation would have an annual operating budget of approximately \$600,000 to \$800,000.

Each year the Foundation would estimate the amount of money available for implementation and select priority actions for funding. If the Foundation determines that there is an existing public agency that is most appropriate to implement a particular action, the Foundation would execute a contract with that agency. For those CCMP recommendations where no appropriate agency is identified for implementation, the Foundation would advertise a request for qualifications through the Business Commerce Daily or the Foundation's mailing list.

REDIRECTION OF CURRENT PROGRAMS

Funds to implement a variety of environmental programs are appropriated by federal and state agencies every year. These funds are generally allocated to an issue (i.e., point source pollution control, wetlands enhancement, education) and not to a specific geographic area. Over 125 federal and state programs have been identified that could be used to implement most of the Delaware Estuary Program's CCMP recommendations. Some of these programs provide funds in the form of grants, loans, or cost-sharing, while others provide for technical assistance, information, or research on behalf of the requesting party. A matrix that links individual CCMP actions to existing programs can be found in the Program's Financial Plan, Appendix G.

The Delaware Estuary Foundation will negotiate with appropriate federal and state decision-makers to secure priority funding status for CCMP actions within existing programs. As an example, one federal program that is not currently being used for resource enhancement activities is the State Revolving Fund Program. Established by the Water Quality Act Amendments of 1987, this program makes capitalization grants available to states that have created revolving funds. The purpose of these revolving funds is to provide assistance to local communities for water quality projects and activities. The primary focus of revolving funds is financing local wastewater treatment facilities. However, the Act also states that revolving funds can be used to finance the implementation of nonpoint source pollution control plans, wetland programs, and estuary CCMPs.

PUBLIC/PRIVATE AND PUBLIC/PUBLIC PARTNERSHIPS

Public/private partnerships are agreements between public and private entities to work together to meet some environmental need. Examples of such partnerships include the privatization of a public utility, private funding for public programs, joint public/private funding for a project benefitting both parties, and allowing the use of public property by a private interest in exchange for having the private interest provide a public service. Public/public partnerships are agreements between a public agency and a public authority, such as a port or solid waste authority; these work in the same way as public/private partnerships.

The Delaware Estuary Program has been successful in establishing three public/private partnerships to date. One company funded the printing of the Program's bumper sticker and loaned the Program audio/visual equipment; the Public Service Electric and Gas Company designed and sponsored a series of newspaper advertisements on behalf of the Program; and the Program and DRBC jointly funded a project on data management.

FEES FOR SERVICES

Fees for services can be charged if there is a demand for a service or if there is an identified group of individuals or organizations that are directly responsible for negative impacts on natural resources. An example of public demand for a service is the need of a neighborhood to have its septic systems pumped out regularly. The local government could put together a package deal for the neighborhood and tax the residents for the service at a better rate than each homeowner could contract for the service individually.

Potential fee
for service
programs that
could be
implemented
at the local
government
level:

- Aquifer
Protection
Districts
- Betterments
- Drainage
Districts
- Flood
Control
Zone
Districts
- Health
Districts
- Storm and
Surface
Water
Utilities
- Stormwater
Utilities



A stormwater utility, through which a municipality taxes its residents for stormwater control, is another example of a service fee. These types of programs can also be funded through general obligation and revenue bonds.

CHANGES TO FEDERAL LAW

Potential changes to federal laws, such as the Clean Water Act, the Coastal Zone Management Act, and the Farm Bill, could provide funding for CCMP actions by including provisions for CCMP implementation grants and the redirection of penalties.

REGIONAL ECONOMIC DEVELOPMENT PROJECTS

The Delaware Estuary Foundation and Council should work with the Delaware River Port Authority and the Delaware River and Bay Authority to support specific projects and direct economic development funds in a manner consistent with the goals and objectives of the Plan.

D. Consistency as an Implementation Tool

Section 320(b) of the Clean Water Act allows National Estuary Programs to review all federal financial assistance programs and development projects to determine whether these programs or projects would be consistent with and further the purposes and objectives of the CCMP. This consistency review provision ensures that federal actions do not adversely affect CCMP goals, and that they support actions proposed in the CCMP wherever possible.

The consistency review process allows the Delaware Estuary Program to influence federal actions and, in some cases, to stop federal actions that conflict with the CCMP. As an implementation mechanism, it could be useful in influencing planning and work plan development of federal agencies such as USEPA, USFWS, USDA-SCS, and USDOT.

The selection of federal programs to be reviewed will depend on their association with water quality, habitat, water use, or land use problems; whether they provide substantial funding in the region; and program or project size. Programs that could implement specific CCMP actions will also be targeted for

The consistency review process allows the Delaware Estuary Program to influence federal actions and, in some cases, to stop federal actions that conflict with the CCMP.

consistency review. The Delaware Estuary Program will seek to resolve inconsistencies through negotiation with the federal agencies.

For particularly significant programs, Memoranda of Understanding will be developed with the responsible federal agencies, to include coordination opportunities; procedures for establishing priorities, commitments, budget and staff; and progress reporting.

After an initial review of applicable programs, the Delaware Estuary Program will establish a continuing review process, for which two mechanisms are available. One is based on the Executive Order 12372 process, that allows states to comment on federal projects. This process is limited in that it does not require agencies to comply with the CCMP. The other mechanism is the state Coastal Zone Management Program (CZMP) consistency review process. Coastal Zone Management programs in all three states include federal consistency review procedures which provide powerful authorities to seek amendment of federal actions, including a veto authority. However, this authority is only available if enforceable CCMP policies are incorporated into the CZMP. In order to incorporate these policies, the Delaware Estuary Program will have to complete a detailed comparison of CCMP and CZMP policies in each state. The states will then have to formally incorporate the enforceable policies. For those CCMP actions that cannot be incorporated, the CZMP can simply serve as a mechanism for providing comments to federal agencies, much like the executive order process.

The final version of the CCMP will include a detailed plan for continued review of federal actions. It is anticipated that the Coastal Zone Management Programs will be the primary mechanism for reviewing federal activities for consistency, even where incorporation is not possible.

An essential part of implementation is the development of CCMP guidance for review agencies and federal agencies that will be cooperating in implementing the CCMP. This guidance will describe how the federal agency actions will be evaluated for consistency with CCMP goals and action plans.





E. Putting the CCMP in Place

Because of the comprehensive nature of the Plan, success depends upon coordinated actions by local, state, and federal agencies and other organizations identified for specific activities.







The roles of the major partners in Estuary management under the Plan are summarized below. At a more specific level, the individual actions within the Plan identify lead agencies and participating partners.

THE FEDERAL ROLE



-  Participate in and help fund the Delaware Estuary Foundation.
-  Prioritize actions for federal agency operating budgets and grant programs.
-  Develop Memoranda of Understanding between federal and state agencies to better coordinate environmental protection efforts.
-  Provide mapping tools and products to facilitate monitoring and cumulative impact assessment.


THE STATE ROLE

The success of the Plan will depend directly on both active state agency participation in the Estuary Council and the fulfillment of commitments concerning specific initiatives. State roles include:

-  Participate in and help fund the Delaware Estuary Foundation.
-  Prioritize actions for state agency operating budgets and grant programs.
-  Develop Memoranda of Understanding between federal agencies and agencies of other states to better coordinate environmental protection efforts.
-  Provide mapping tools and products to facilitate monitoring and cumulative impact assessment.






THE REGIONAL ROLE

-  Participate in the Estuary Council and/or Foundation.
-  Prioritize actions for regional agency operating budgets.

-  Receive and spend public money as directed by the Estuary Council/Foundation (DRBC).



THE LOCAL GOVERNMENT ROLE

There are portions of 22 counties and over 500 municipalities, townships, and boroughs in the Delaware Estuary watershed. Community involvement is critical to the ultimate success of the Plan in achieving a cleaner, healthier, more productive ecosystem. Roles of local jurisdictions include:

-  Serve on the Estuary Council and/or Foundation and provide a voice for ongoing management.
-  Form compacts and/or agreements with adjacent communities and counties to address environmental issues that are watershed in scope.
-  Incorporate habitat protection provisions into master plans and development ordinances.
-  Incorporate "best management" stormwater management practices into master plans and development ordinances.
-  Provide input and comments on environmental policies.

THE ROLE OF STAKEHOLDERS




Stakeholders include civic, conservation, and environmental organizations, industries, small businesses, the commercial and recreational fishing community, developers, boaters, and the public at large. All of these stakeholders will be affected by the Plan and share responsibility for its implementation. The partnership approach to resource protection has been emphasized in the Plan and will be even more important in its implementation. Addressing sustainable development challenges will require fundamental behavioral changes and broad support from all stakeholder groups. Stakeholder involvement includes:

-  Serve on the Estuary Council and/or Foundation and provide a voice for ongoing resource management.
-  Provide input and comments on environmental and economic policies affecting the Estuary.

Addressing the challenges of sustainable development will require fundamental behavioral changes and broad support from all stakeholder groups.



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-  Assist with funding, volunteer, and in-kind services to support implementation.
-  Assist with public outreach and educational efforts.
-  Support legislative efforts at the federal, state, and local levels.

F. Summary

This Plan — the CCMP — has been developed as a blueprint for restoring and protecting the Estuary. Unlike more traditional planning efforts, the Delaware Estuary Program offered an unusual opportunity: it asked the public for help in developing a plan for the resource, rather than to just accept one prepared by government agencies. People representing a wide variety of interests — business people, environmentalists, teachers, planners — have helped to shape this Plan. You, the person who cares enough to read it and become involved, are the person who can make this Plan a reality.

Make the Program vision a reality and take the pledge

We the people of the Delaware Estuary watershed recognize its importance, and our linkage to it. We are committed to do our part to protect and enhance it. Our primary relationship to the Delaware is one of stewardship. We know what and where our most sensitive environmental resources are, and we will honor and protect them. The diversity and abundance of plants and animals throughout the Delaware Estuary are of great importance and value to us. We support actions to establish a fair and honest balance between the needs of recreational and commercial fisheries and a sustainable fish and shellfish level. We exhort our local, state, federal, and private entities to develop workable, integrated, regional watershed approaches to protect habitat, ensure good water quality, and manage land use including sound port management and economic development consistent with the environmental needs of the Delaware Estuary.

APPENDIX A

GLOSSARY

Anadromous fish: Fish that spend their adult lives in the sea but swim upriver to fresh water to breed (striped bass, American shad, river herring, and sturgeon).

Aquatic environment: The water and land covered by water in lakes, ponds, streams, rivers, estuaries, and oceans.

Ballast water: Water carried in a ship to provide stability after cargo has been taken ashore.

Benthos: Plants and animals that live on the bottom of aquatic environments.

Best Management Practice (BMP): A method, activity, maintenance procedure or other management practice for reducing the amount of pollution entering a water body.

Biodiversity (Biological diversity): The variety of life and its processes, including the variety of living organisms and the genetic differences between them and the communities in which they occur.

Bioconcentration (also food chain amplification, bioaccumulation, biomagnification): A process resulting in concentration of persistent, fat-soluble compounds (e.g., PCBs, DDT, methyl mercury) in the top carnivores of the food chain.

Biomarker: A contaminant induced alteration in organisms at the cellular level that can be used as an early warning signal for predicting biological effects that may lead to decreased survival and reproductive capacity.

Brackish: Having a salinity between that of fresh and sea water (saltier than fresh, not as salty as the sea).

Catadromous fish: Fish that migrate downstream in the direction of the sea, usually to reproduce (American eel).

Co-generation: The simultaneous production of electricity and useful thermal energy from a single power source.

Combined Sewer Overflow: A pipe that, during storms, discharges untreated wastewater from a sewer system that carries both sanitary wastewater and stormwater. The overflow occurs because the system does not have the capacity to transport and treat the increased flow caused by stormwater runoff.



Cyanobacteria: Bacteria (formerly called blue-green algae) that have the photo-synthetic metabolism of plants but the cellular structure of bacteria.

Demersal: Living in the bottom waters of a water body.

Depletive water use: A use which permanently removes water from a Basin.

Dermo (*Dermocystidium (marinum)*): A parasitic microorganism (protozoan animal) that infects oysters and causes extensive mortalities.

Diatoms: A class of planktonic one-celled algae with skeletons of silica.

Diminution: The act or process of diminishing; decrease.

Dredging: Removing bottom material from a waterway.

Ecosystem: A natural unit formed by the interaction of a community of organisms with its environment.

Estuary: A coastal water body, with tidal mixing, where fresh water from rivers mixes with salt water from the ocean.

Eutrophication: The process during which a water body becomes highly loaded with nutrients, (primarily nitrogen and phosphorous), sometimes causing oxygen depletion from unconsumed algal production.

Flocculation: A process involving the aggregation of fine particles, either suspended in or precipitated from a solution.

Geographic Information Systems (GIS): A computer system that enables one to create electronic maps to depict various types of data, such as wetland coverages, toxic waste sites, etc.

Ground truthing: The field checking of sites on the ground to reliably determine resource types and conditions. These data are used in relationship to classifications made from aerial photography and/or satellite images, to determine classification accuracy.

Impoundment: An area of tidal marsh that has been cut off from tidal inundation through the construction of dikes, dams, or other water control structures.

MSX parasite (*Haplosporidium nelsoni*, "Multinucleated sphere X unknown"): A spherical, single-celled organism containing many nuclei belonging to a small group of spore-forming parasites of invertebrates. MSX is found only in oysters and causes extensive mortalities.

Neotropical: New World (the Americas) tropics.

Nonpoint source: An indirect discharge, not from a pipe or other specific source.

Oyster drill: A predatory snail species that feeds on oysters by boring through their shell.

Passerines: Songbirds.

Pathogens: Biological agents, such as bacteria and viruses, that cause sickness or disease. Common sources in the Delaware Estuary include wastewater treatment plants, CSOs, and nonpoint source runoff.

Pelagic: Living in the open water.

***Phragmites australis*:** A common reed grass, generally considered a pest plant, because of its tendency to replace other valuable vegetation by forming dense monoculture stands.

Phytoplankton: Microscopic algae that are freely floating in aquatic systems.

Raptors: Birds of prey, such as bald eagles, osprey, peregrine falcons.

Riparian: Along river banks.

Successional meadows: A large treeless area that is dominated by grasses and small woody and non-woody plants.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Terrestrial: Pertaining to the land and land habitats as opposed to aquatic habitats.

Transfer of Development Rights (TDRs): A system for voluntary land preservation in which the property owner is paid not to develop land.

Upconing: The situation where a producing well is located close enough to saline water underlying fresh water and pumped at a rate sufficient to cause the salt water to be drawn up into the well in an upward shaped cone or mound.

Uplands: Terrestrial areas above the influence of tidal waters.

Wasteload allocation: A Total Maximum Daily Load (TMDL) is the total amount of a pollutant that can be released into a receiving water by all dischargers without causing a violation of water quality standards. A wasteload allocation determines how much of the total loading each source of the pollutant will be allowed to discharge.



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Watershed: A geographic area in which water, sediments, and dissolved materials drain to a common water body.

Water quality standards: State regulations which outline permissible levels of individual pollutants in specific bodies of water.

Wetland: An ecosystem type, generally occurring between upland and deepwater areas, that performs many important functions including: fish and wildlife habitat, flood protection, erosion control, water quality maintenance, and recreational opportunities.

APPENDIX B

REFERENCES FOR CHAPTER II – STATE OF THE ESTUARY

- Albert, R.C., 1988. Human Use: Pollution. In: The Delaware Estuary: Rediscovering a Forgotten Resource. Univ. of Delaware Sea Grant College Program, Newark, DE.
- Belton, T.J., B.E. Ruppel, and K. Lockwood, 1982. "PCSs (Aroclor 1254) in Fish Tissues Throughout the State of New Jersey. A Comprehensive Survey". New Jersey Department of Environmental Protection. Trenton, New Jersey.
- Berger, J., J.W. Sinton and J. Radke, 1994. History of the Human Ecology of the Delaware Estuary. A Report to the Delaware Estuary Program by Expert Information Systems, Inc., 100 pp.
- Biggs R.B. and T.M. Church, 1984. Bottom Sediments. In: J.H. Sharp, (ed.), The Delaware Estuary: Research Background for Estuarine Management and Development. A Report to the Delaware River and Bay Authority.
- Brush, G., 1994. Biostratigraphy of the Delaware Estuary. Final draft report submitted to the Delaware Estuary Program. Department of Geography and Environmental Engineering, Johns Hopkins University.
- Cahill Associates, 1993. "A Report on the Upper Perkiomen Watershed". Sponsored by the Delaware Riverkeeper, Lambertville, New Jersey.
- Chervin, M.B., T.C. Malone and P.J. Neale, 1981. Interactions Between Suspended Organic Matter and Copepoda Grazing in the Plume of the Hudson River. Estuary. Coast. Shelf Sci. 13:169-183.
- Church, T.M., J.M. Tramontano, J.R. Scudlark, and S.L. Murray, 1988. Trace Metals in the Waters of the Delaware Estuary, p. 93-115. In: S.K. Majumdar, E.W. Miller, and L.E. Sage, eds., Ecology and Restoration of the Delaware River Basin. Penn. Acad. Sci.
- Clark, K., 1991. Osprey Management in New Jersey, 1989. New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife. Trenton, New Jersey.
- Costa, H.J. and T.C. Sauer, 1994. Distribution of Chemical Contaminants and Acute Toxicity in Delaware Estuary Sediments. Delaware Estuary Report prepared by A.D. Little, Inc.
- Culliton, C., et al, 1990. Fifty Years of Population Change Along the Nation's Coast 1960-2010. National Oceanic and Atmospheric Administration.



DRAFT CCMP

- Daiber, F.C., 1988. Fisheries Resources of the Delaware Estuary. In: Mujaudar, E.W. Miller, and L.E. Sage, Eds. Penn. Academy of Sciences. pp. 169-185.
- Daiber, F.C. and C.T. Roman, 1988. Tidal Marshes, p. 95-113. In: The Delaware Estuary: Rediscovering a Forgotten Resource. T.L. Bryant, J.R. Pennock (eds.), Univ. of Delaware Sea Grant College Program, 144 pp.
- Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia, 1989. Estuarine Ecology. John Wiley & Sons, New York, 558 pp.
- Delaware River Basin Commission, 1994. "Delaware River and Bay Water Quality Assessment 1992-1993 305b Report".
- Delaware River Basin Commission, 1993. Sediment Contaminants of the Delaware River Estuary. Estuary Toxics Management Program, Delaware River Basin Commission, West Trenton, New Jersey.
- Delaware River Basin Commission, 1991. Ambient Toxicity Study of the Delaware River Estuary, Phase I. Estuary Toxics Management Program, Delaware River Basin Commission, West Trenton, New Jersey.
- Delaware River Basin Commission, 1988. Fish Health and Contamination Study. DEL USA Project Element 10. Delaware Estuary Use Attainability Project, Delaware River Basin Commission. West Trenton, New Jersey.
- Delaware Valley Regional Planning Commission, 1994. Status and Trends of the Delaware Estuary Watershed. Contract work for the Delaware Estuary Program, 44 pp.
- DiLorenzo, I.L., G.R. Marino, G.R. Huang, P. Najarian, T.O., and M.L. Thatcher, 1992. Hydraulic Controls on Delaware Estuary Water Quality. In: Hydraulic Engineering, Saving a Threatened Resource - In Search of Solutions. American Society of Civil Engineers, Proc. of the Hydraulic Engineering sessions at Water Forum 1992. Jennings, M.E., and N.G. Bhowmik (Eds.), Baltimore, Maryland. August 2-5, 1992, pp. 151-157.
- Environmental Resources Research Institute, 1994. Land Use and Nonpoint Pollution Study of the Delaware River Basin.
- Ferren, W.R. and A. Schuyler, 1980. Intertidal Vascular Plants of River Systems near Philadelphia. Proceedings of the Academy of Natural Sciences of Philadelphia, 132:86-120.

REFERENCES

- Frake, A.C., J.H. Sharp, S.E. Pike, J.R. Pennock, C.H. Culberson, and W.J. Canzonier, 1984. Nutrients (Nitrogen, Phosphorus, Silicon). In: *The Delaware Estuary: Research as Background for Estuarine Management and Development* (J.H. Sharp, ed.). A report to the Delaware River and Bay Authority.
- Frithsen, J.B., K. Killam, and M. Young, 1991. An Assessment of Key Biological Resources in the Delaware River Estuary. Report prepared for the EPA Delaware Estuary Program by Versar, Inc.
- Gastrich, M.D., 1992. Characterization Summary and Synthesis Report for the Delaware Estuary Program Preliminary Conservation and Management Plan". New Jersey Department of Environmental Protection. Trenton, New Jersey.
- Gloucester County Planning Department, 1992. Clean Water Works: Watershed Management.
- Goodell, Robert L., 1988. Water Management and Hydrology in the Delaware River Basin. In: *Ecology and Restoration of the Delaware River Basin*, The Pennsylvania Academy of Science.
- Greeley Polhemus Group, Inc., 1994. Land Use Management and Nonpoint Source Control for the Delaware Estuary: The Pennsylvania Demonstration Project.
- Greeley-Polhemus Group, Inc., 1993. Assessment of Selected Delaware Estuary Economic and Natural Resource Values.
- Hargreaves, B.R. and J.N. Kraeuter, 1989. The State of Living Resources in the Delaware Estuary. Document supporting presentation made in October 1989. Delaware Estuary Program Workshop. College of Marine Studies, Univ. of DE, Newark, DE.
- Haskin, H.H., R.A. Lutz, and C.E. Epifanio, 1984. Chapter 13: Benthos (Shellfish). In: Sharp, J.H., ed. *The Delaware Estuary: Research as Background for Estuarine Management and Development*. Univ. Del. and N.J. Marine Sci. Consort.
- Herman, S.S. and B.R. Hargreaves, 1988. First Order Estimate of Secondary Productivity in the Delaware Estuary, Chapter 9, p. 148-156 and page 431. In Majumdar, S.K., E.W. Miler, and L.E. Sage (eds.) *Ecology and Restoration of the Delaware River Basin*. The Pennsylvania Academy of Science, Easton, Pennsylvania.
- Hires, R.I., G.L. Mellor, L.Y. Oey, and R.W. Garvine, 1984. Circulation of the Estuary. In: *The Delaware Estuary: Research as Background for Estuarine Management and NOAA, 1987. Benthic Surveillance Program, National Status and Trends Program*. Technical Memorandum NOS OMA 38.



- Jarman, W.M., et al, 1993. Organochlorines, Including Chlordane Compounds and their Metabolites, in Peregrine Falcon, Prairie Falcon and Clapper Rail Eggs from the U.S.A. *Envir. Poll.* Vol. 81, pp. 127-136.
- Karish, John F., 1988. Outdoor Recreation along the Delaware River. In: *Ecology and Restoration of the Delaware River Basin*. The Pennsylvania Academy of Science.
- Kerlinger, Paul and David Wiedner, 1991. The Economics of Birding at Cape May, New Jersey. *Human Dimensions in Wildlife newsletter*, Cornell University. Volume 8, No. 3.
- Killam, K.A. and W.A. Richkus, 1992. An Assessment of Fisheries Landings Records in the Delaware Estuary. Prepared for Delaware Estuary Program, U.S. Environmental Protection Agency, by Versar, Inc., Columbia, Maryland. 190pp.
- Kiry, P.K., 1974. An Historical Look at the Water Quality of the Delaware River Estuary to 1973. Contribution #4. Dept. of Limnology, Academy of Natural Sciences of Philadelphia. 76 pp.
- Lebo, M.E. and J.H. Sharp, 1992. Modeling Phosphorus Cycling in a Well-Mixed Coastal Plain Estuary. *Estuarine Coastal Shelf Science* 35:235-252.
- Maiden, A.L., D.A. Randle, and S.R. Goldman, 1977. Abundance and Distribution of Ichthyoplankton. In: *An Ecological Study of the Delaware River in the Vicinity of Artificial Island*. Progress Report for January through December, 1976.
- Malone, T.C. and M.B. Chervin, 1979. The Production and Fate of Phytoplankton Size Fractions in the Plume of the Hudson River, New York Bight. *Limnol. Oceanogr.* 24:683-693.
- Marino, G.R., J.L. DiLorenzo, H.S. Litwack, T.O. Najarian, and M.L. Thatcher, 1992. General Water Quality Assessment and Trend Analysis of the Delaware Estuary. Part I. General Status and Trend Analysis. Report to the Delaware Estuary Program. USEPA, Philadelphia, Pennsylvania, p. 217.
- Marshall, H.G., 1992. Assessment of Phytoplankton Species in the Delaware River Estuary. Final Report. Prepared for Delaware River Basin Commission, West Trenton, New Jersey.
- McHugh, J.L., 1966. Management of Estuarine Fisheries. *American Fisheries Society Special Publication*. 3:133-154.
- McNair, 1991. Status and Trends of Toxic Pollutants in the Delaware Estuary. Division of Environmental Research, Academy of Natural Sciences of Philadelphia. Report 91-14 to the Delaware Estuary Program.
-

REFERENCES

- Meredith, W.H. and D.E. Savekis, 1987. Effects of Open Water Marsh Management (OMWM) on Bird Populations of a Delaware Tidal Marsh, and OMWM's Use in Waterbird Habitat Restoration and Enhancement. In: Waterfowl and Wetlands Symposium. Delaware Dept. of Natural Resources and Environmental Control and Delaware Coastal Management Program. Dover, DE, p. 199-321.
- Niles, L., K. Clark, and D. Ely, 1991. Breeding Status of Bald Eagles in New Jersey. New Jersey Audubon Society, Vol. 17, No. 1.
- O'Herron, J.C., II, T. Lloyd, and K. Laidig, 1993. A Survey of Fish in the Delaware Estuary from the Area of the Chesapeake and Delaware Canal to Trenton. Draft final report prepared for Delaware Estuary Program, Environmental Protection Agency, Region II.
- Pagano, M. and L. Saint-Jean, 1994. *In Situ* Metabolic Budget for the Calanoid Copepoda *Acartia clausi* in a Tropical Brackish Water Lagoon (Ebrie Lagoon, Ivory Coast). *Hydrobiologia* 272:174-161.
- Palmer, M.A., 1994. Invertebrates Drift: Behavioral Experiments with Intertidal Meiobenthos. *Mar. Behav. Physiol.* 10:235-253.
- Pennock, J.R. and J. Sharp, 1986. Phytoplankton Production in the Delaware Estuary: Temporal and Spatial Variability. *Mar. Ecol. Prog. Ser.* 34:143-155.
- Philipp, 1994. Tidal Wetlands Characterization - Then and Now. Draft report to the Delaware Estuary Program.
- Price, K.S., R.A. Beck, S.M. Tweed, and C.E. Epifanio, 1988. Fisheries, p. 71-93. In: The Delaware Estuary: Rediscovering a Forgotten Resource. T.L. Bryant, J.R. Pennock (eds.), University of Delaware Sea Grant College Program.
- Riedel, G.F. and J.G. Sanders, 1993. Trace Element Speciation and Behavior in the Tidal Delaware River. Final report to the Delaware Estuary Program. January, 1993.
- Sanders, J.G. and G.F. Riedel, 1992. Factors Limiting Primary Production in the Urban Delaware River. Final report. Report No. 92-35. The Academy of Natural Sciences, Benedict, MD.
- Sautour, B. and J. Castel, 1993. Distribution of Zooplankton Populations in Marennes-Oleron Bay (France), Structure and Grazing Impact of Copepoda Communities. *Oceanol. Acta* 16:279-290.
- Scheier, A. and P. Kiry, 1973. A Discussion of the Effects of Certain Potential Toxicants on Fish and Shellfish in the Upper Delaware Estuary. A report to the National Science Foundation RANN Program. By the Academy of Natural Sciences of Philadelphia. 54 pp.
-



- Sharp, J., 1994. What Not to Do About Nutrients in the Delaware Estuary. In: K. Dyer, ed., *Changes in Fluxes in Estuaries. Implications from Science to Management*. Olsen and Olsen, Fredensborg, Denmark.
- Sharp, J., 1988. Trends in Nutrient Concentrations in the Delaware Estuary, pp. 77-92. In: S.K. Majumdar, E.W. Miller, and L.E. Sage (eds.), *Ecology and Restoration of the Delaware River Basin*.
- Sharp, J.H., L.A. Cifuentes, R.B. Coffin, J.R. Pennock, and K.C. Wong, 1986. The Influence of River Variability on the Circulation, Chemistry and Microbiology of the Delaware Estuary. *Estuaries*, 9:261-269.
- Sharp, J.H., J.R. Pennock, T.M. Church, J.M. Tramontano, and L.A. Cifuentes, 1984. The Estuarine Interaction of Nutrients, Organics, and Metals: A Case Study in the Delaware Estuary. In: V.S. Kennedy-Ed. *The Estuary as a Filter*. Academic Press (Orlando, FL) pp. 241-258.
- Sharp, J.H., C.H. Culberson, and T.M. Church, 1982. The Chemistry of the Delaware Estuary: General Considerations. *Limnol. Oceanogr.* 27:1015-1028.
- Shuster, C.N., 1985. A Contribution to the Population Biology of Horseshoe Crabs, *Limulus polyphemus* (L.), in Delaware Bay. *Estuaries* 8(4):363-372.
- Smullen, J.T., J.H. Garvine, R.W. and H.H. Haskin, 1983. River Flow and Salinity. In: *The Delaware Estuary: Research as Background for Estuarine Management and Development - A Report to the Delaware River and Bay Authority*. J.H. Sharp (ed.), University of Delaware College of Marine Studies and New Jersey Marine Sciences Consortium.
- Stearns, D.E. and M.R. Dardeau, 1990. Nocturnal and Tidal Vertical Migrations of "Benthic" Crustaceans in an Estuarine System with Diurnal Tides. *Northeast Gulf Sci.* 11:93-104.
- Stearns, D.E., W. Litaker, and G. Rosenberg, 1987. Impacts of Zooplankton Grazing and Excretion on Short-Interval Fluctuations in Chlorophyll and Nitrogen Concentrations in a Well-Mixed Estuary. *Estuar. Coast. Shelf Sci.* 24:305-325.
- Steidl, R.J., C.R. Griffin, and L.J. Niles, 1991A. Differential Reproductive Success of Ospreys in New Jersey. *J. Wildlife Management* Vol. 55., No. 2, pp. 226-272.
- Steidl, R.J., C.R. Griffin, L.J. Niles, 1991B. Reproductive Success and Eggshell Thinning of a Re-established Peregrine Falcon Population. *J. Wildlife Management* Vol. 55, No. 2, pp. 294-299.

REFERENCES

- Steidl, R.J., C.R. Griffin, L.J. Niles, 1991C. Contaminant Levels of Osprey Eggs and Prey Reflect Regional Differences in Reproductive Success. *J. Wildlife Management* Vol. 55, No. 4, pp. 601-608.
- Stein, M., M. Docherty, R. Jung, and J.P. Myers, 1988. Migratory Shorebirds. In: *The Delaware Estuary: Rediscovering a Forgotten Resource*. University of Delaware Sea Grant Program.
- Stepien, J.C., T.C. Malone, and M.B. Chervin, 1981. Copepoda Communities in the Estuary and Coastal Plume of the Hudson River. *Estuar. Coast. Shelf Sci.* 13:185-195.
- Sutton, C., 1988. Wintering Raptors and Waterfowl on the Maurice River. *Records of New Jersey Birds* 14(32):42-50.
- Sutton, C., C. Schultz, and P. Kerlinger, 1991. Autumn Raptor Migration Along New Jersey's Delaware Bayshore: A Hawk Migration Study at East Point, New Jersey. In: *Hawk Migration Studies (Journal of the Hawk Migration Association of North America)* 16(1):58-64.
- Tiner, R.W., Jr., 1985. Wetlands of Delaware. Cooperative Publication, National Wetlands Inventory Project, U.S. Fish and Wildlife Service Region 5, Newton Corner, MA and Division of Environmental Control, Delaware Dept. of Natural Resources and Environmental Control, Dover, DE, 77pp.
- Tiner, R.W., 1985. Wetlands of New Jersey. National Wetlands Inventory Project, U.S. Fish and Wildlife Service Region 5, Newton Corner, MA.
- Tiner, R.W., J.C. Anderson, and W. Zinni, 1987. Current Status and Recent Trends in Wetlands of the Delaware Estuary Coastal Zone of Pennsylvania. National Wetlands Inventory Program. U.S. Fish and Wildlife Service Region 5, Newtown Corner, MA.
- Tiner, Ralph W., Jr. and Bill O. Wilen, 1988. Wetlands of the Delaware River Basin. In *Ecology and Restoration of the Delaware River Basin*. The Pennsylvania Academy of Science.
- U.S. Environmental Protection Agency, 1986. 305b Water Quality Reports.
- U.S. Fish and Wildlife Service, 1993. Concentrations of Organochlorines and Trace Elements in Fish and Blue Crabs from the Delaware River, Easton to Deepwater. Pennsylvania Field Office Special Project Report 93-5, State College, PA.
- Versar, Inc., 1994. Estimates of Contaminant Inputs to the Delaware Estuary from Nonpoint Sources. Contract draft report to the Delaware Estuary Program.



DRAFT CCMP

- Wang, C.S. Johnson, and R.J. Kernehan, 1979. Fishes of the Delaware Estuaries: A Guide to Early Life Histories. EA Communications. Ecological Analysts, Inc., Towson, MD.
- Weakfish Review Team, 1990. Annual Report on the Status and Trends of the Atlantic Weakfish.
- Wiedner, D.S., P. Kerlinger, D. Sibley, P. Holt, J. Hough, and R. Crossley, 1992. Visible Morning Flight of Neotropical Landbird Migrants at Cape May, New Jersey. *The Auk*, 109 (3):500-510.

REFERENCES FOR CHAPTER III – LAND MANAGEMENT

- Arendt, Randall, 1994. Designing Open Space Sudivisions, A Practical Step-by-Step Guide. Natural Lands Trust.
- Greely-Polhemus Group, Inc., 1992. Delaware Estuary Program Inventory and Assessment. For the Delaware Estuary Program.
- John, Dewitt, 1994. Civic Environmentalism: Alternatives to Regulation in States and Communities. CQ Press.
- Leopold, Aldo, 1949. Land Ethic.
- New Jersey State Planning Commission, 1992. Communities of Place, the New Jersey State Development and Redevelopment Plan.
- Robinson, G., M. Yurlina, and S. Handel, 1994. "A Century of Change in the Staten Island Flora: Ecological Correlates of Species Losses and Invasions" . In: Bulletin of the Torrey Botanical Club, 121 (2).
- Roy F. Weston, Inc., 1992. Delaware Estuary Regulatory Programs Inventory and Assessment. For the Delaware Estuary Program.
- Smith, Tim, 1993. "Toward Sustainable Farming Communities: Community Planning and Design in Suburbanizing Farming Regions." In: American Institute of Architects On-Line Publication, Washington, D.C.

**RESOURCES FOR FURTHER READING ON
GROWTH MANAGEMENT, LAND USE PLANNING
AND NONPOINT SOURCE POLLUTION**

- Anacostia Restoration Team, 1991. Watershed Restoration Sourcebook. Metropolitan Washington Council of Governments.
- Barkley, Paul, 1973. Economic Growth and Environmental Decay. Harcourt Brace.
- Brandes, Charles, 1973. Methods of Synthesis for Ecological Planning. University of Pennsylvania.
- Cahill Associates, 1989. Stormwater Management in the New Jersey Coastal Zone. For New Jersey Department of Environmental Protection.
- Corbett, Michael, 1981. A Better Place to Live. Rodale Press.



DRAFT CCMP

- Coughlin, R., J. Denworth, and J. Rogers, 1991. Guiding Growth. Pennsylvania Environmental Council.
- Doppelt, et al., 1993. Entering the Watershed. The Pacific Rivers Council.
- Dunne and Leopold, 1978. Water in Environmental Planning. Freeman.
- Kunstler, James, 1994. The Geography of Nowhere. Touchstone.
- McHale, John, 1970. The Ecological Context. Braziller.
- Ortolano, Leonard, 1981. Environmental Planning and Decision Making. Stanford University.
- Real Estate Research Corporation, 1974. The Costs of Sprawl. Environmental Protection Agency.
- Schueler, T.R., 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Council of Governments.
- USEPA, Office of Wetlands, Oceans and Watersheds. "Coastal Protection Program". Washington, D.C.

REFERENCES FOR CHAPTER V — HABITAT AND LIVING RESOURCES

- Culliton, C. et al., 1990. 50 Years of Population Change along the Nation's Coast 1960 - 2010. National Oceanic and Atmospheric Administration.
- Delaware Basin Fish and Wildlife Management Cooperative, 1985. A Policy and Recommendations Relating to Fishways Within the Delaware Basin, 37 pp. and Appendix.
- Delaware's Environmental Legacy: Report to the Governor and the People of Delaware. January 1988.
- Ford, R.G. and D. Henne, 1993. The Vulnerability of Migrating Shorebirds to Oil Spills in the Delaware River Estuary. Paper presented at the Shorebird Workshop, New Jersey DEPE, May 1993.
- Framer, W.E., 1991. Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1970's to 1980's. U.S. Fish and Wildlife Service, 31pp.
- Kerlinger, P. Delaware Tributary Greenway Project, 1993, and personal communication.
- Kraft, J.C., H. Yi, and M.D. Khalequzzaman, 1992. Geologic and Human Factors in the Decline of the Tidal Saltmarsh Lithosome: The Delaware Estuary and Atlantic Coastal Zone. *Sedimentary Geology* 80: 232-246.
- McCorkle, R., 1992. U.S. Fish and Wildlife Service and the States of Delaware and New Jersey. Nomination Report to the Convention on Wetlands of International Importance.
- Meredith, W., 1994. Delaware Department of Natural Resources and Environmental Control. Personal communication.
- Niles, L. Table 2 from presentation at Shorebird Workshop, May 1993.
- Philipp, Kurt, 1994. Tidal Wetlands Characterization - Then and Now. Report prepared for the Delaware Estuary Program by Wetland Research Associates, Inc. 81 pp. and Appendices.
- Reid, W. and M. Trexler, 1991. Drowning the National Heritage: Climate Change and U.S. Coastal Biodiversity. World Resources Institute.
- Robbins, C.S., D.K. Dawson, and B.A. Dowell, 1989. Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States. Wildlife Monographs, 103. The Wildlife Society, Washington, D.C.



DRAFT CCMP

- Safina, C. and K. Hinman, 1991. Stemming The Tide: Conservation of Coastal Fish Habitat in the United States. Summary of a National Symposium on Coastal Fish Habitat Conservation, Baltimore, MD, 1991. National Coalition for Marine Conservation.
- Seymour, B., 1994. Delaware Valley Regional Planning Commission. Personal communication.
- Tiner, R.W., Jr., 1985a. Wetlands of New Jersey. U.S. Fish and Wildlife Service, National Wetlands Inventory. Newton Corner, MA. 117pp.
- Tiner, R.W., Jr., 1985b. Wetlands of Delaware. U.S. Fish and Wildlife Service, National Wetlands Inventory, Newton Corner, MA and Delaware Department of Natural Resources and Environmental Control, Wetlands Section, Dover, DE. Cooperative publication. 77pp.
- Tiner, R.W., Jr., 1990. Pennsylvania's Wetlands: Current Status and Recent Trends. U.S. Fish and Wildlife Service, National Wetlands Inventory, Newtown Corner, MA and Bureau of Water Resources Management, Division of Rivers and Wetlands Conservation, Harrisbury, PA. Cooperative publication. 104pp.
- Smith, G.S. and R.W. Tiner, 1993. Status and Trends of Wetlands in Cape May County, New Jersey and Vicinity (1977 to 1991). U.S. Environmental Protection Agency, Region II, Marine and Wetlands Branch, New York, NY and U.S. Fish and Wildlife Service, Region 5 Ecological Services, Hadley, MA. Cooperative report R-93. 29pp.
- U.S. Fish and Wildlife Service, 1990. Emergency Wetlands Resources Act Regional Wetlands Concept Plan, Northeast Region. .

REFERENCES FOR CHAPTER VI — TOXICS

- Albert, Richard C. 1988. "The Historical Context of Water Quality Management for the Delaware Estuary." *Estuaries*. Vol. 11, No. 2, pp. 99-107.
- Belton, Thomas J., Bruce E. Ruppel, and Keith Lockwood, 1982. "PCBs (Aroclor 1254) in Fish Tissues Throughout the State of New Jersey. A Comprehensive Survey". New Jersey Department of Environmental Protection. Trenton, New Jersey.
- Clark, K., 1991. "1989 Osprey Management in New Jersey." New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife. Trenton, New Jersey.
- Costa, Helder J. and Theodore C. Sauer, 1994. "Distributions of Chemical Contaminants and Acute Toxicity in Delaware Estuary Sediments". Delaware Estuary Report prepared by A.D. Little, Inc.
- Delaware River Basin Commission, 1993. Sediment Contaminants of the Delaware River Estuary. Estuary Toxics Management Program, Delaware River Basin Commission. West Trenton, NJ.
- Delaware River Basin Commission, 1991. Ambient Toxicity Study of the Delaware River Estuary, Phase 1. Estuary Toxics Management Program, Delaware River Basin Commission. West Trenton, NJ.
- Delaware River Basin Commission, 1988. Fish Health and Contamination Study. DEL USA Project Element 10. Delaware Estuary Use Attainability Project, Delaware River Basin Commission. West Trenton, New Jersey.
- Gastrich, Mary Downes, 1992. "Characterization Summary and Synthesis Report for the Delaware Estuary Program Preliminary Conservation and Management Plan". New Jersey Department of Environmental Protection. Trenton, NJ.
- Jarman, W.M, et al., 1993. "Organochlorines, Including Chlordane Compounds and their metabolites, in Peregrine Falcon, Prairie Falcon, and Clapper Rail Eggs from the USA" *Envir. Poll.* Vol 81, pp. 127-136.
- New Jersey Division of Fish, Game and Wildlife, 1993. *Fish and Wildlife Digest* Vol. 6 No. 4, 5pp.
- Niles, Larry, Cathy Clark, and Douglas Ely, 1991. *Breeding Status of Bald Eagles in New Jersey*. New Jersey Audubon Society. Vol 17, No.1.



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- NOAA, 1989. A Summary of Data on Tissue Contamination from the first three years (1986-1988) of the Mussel Watch Project. National Status and Trends Program. NOAA Technical Memorandum NOS OMA 49.
- Paul, J. et al. EMAP Virginian Province Four Year Assessment (1990-1993). EPA Environmental Research Laboratory, Narragansett, R.I. In review October 1994.
- Steidl, Robert J, Curtice R. Griffin, and Lawrence J. Niles, 1991a. "Differential Reproductive Success of Ospreys in New Jersey." J. Wildl. Manage. Vol. 55 No. 2 pp. 226-272.
- Steidl, Robert J, Curtice R. Griffin, Lawrence J. Niles, and Kathleen E. Clark, 1991b. "Reproductive Success and Eggshell Thinning of a Reestablished Peregrine Falcon Population." J. Wildl. Manage. Vol. 55 No. 2, pp. 294-299.
- Steidl, Robert J, Curtice R. Griffin, and Lawrence J. Niles, 1991c. "Contaminant Levels of Osprey Eggs and Prey Reflect Regional Differences in Reproductive Success." J. Wildl. Manage. Vol. 55 No. 4, pp. 601-608.
- US FWS, 1993. "Concentrations of organochlorines and trace elements in fish and Blue Crabs from the Delaware River, Easton to Deepwater". PA Field office Special Project Report 93-5. State College, PA.

APPENDIX C

MANAGEMENT CONFERENCE MEMBERS

POLICY COMMITTEE (AS OF MAY 1994)

Arthur A. Davis, Secretary, PADER
(Represented by Caren Glotfelty, Deputy Secretary for Water Management, PADER)
Jeanne M. Fox, Regional Administrator, USEPA, Region II
Peter H. Kostmayer, Regional Administrator, USEPA, Region III
Robert C. Shinn, Jr., Commissioner, NJDEP
Christophe A. G. Tulou, Secretary, DNREC

MANAGEMENT COMMITTEE

John Burnes, USACE
John Campanelli, Co-Chair, CAC
Neil Christerson, NOAA/OCRM
Mario Del Vicario, USEPA, Region II
Hon. John Adler, Chair, FPC
Karen Holm, Chair, LGC
Richard Pepino, USEPA, Region III
David Pollison, DRBC
Jonathan H. Sharp, Chair, STAC
David Stout, USFWS
James Tabor, PADER
Robert K. Tucker, NJDEP
Representative of New York Department of Environmental Conservation, Vacant
Meghan Wren, Co-Chair, CAC
Robert J. Zimmerman, DNREC

CITIZENS ADVISORY COMMITTEE

John H. Balletto, Robert Boot, Delaware River Basin Electric Utilities Group
John Campanelli (Committee Co-Chair), Susan Carney, National Wildlife Federation Affiliates
Jay Cooperson, Joe Turner, Sierra Club
Carl DeMusz, Allan Dechert, Dave Sedlak, New Jersey Association of Realtors
Charles R. Dutill, Franklin Hartman, Gregory Boyle, New Jersey Water Pollution Control Association
Lorraine Fleming, Linda Stapleford, Connie Logothetis, Delaware Nature Society
Heather Dufur, Ivan Ferron, New Jersey Academy of Aquatic Sciences
Stephen N. Howard, David F. Moore, New Jersey Conservation Foundation
Andrew W. Johnson, Pete Churchill, Hollister Knowlton, Pennsylvania Environmental Council
Capt. Bill Lowe, Pilots Association for the Delaware Bay and River
Ted Nash, John W. Painter, Lisa Himber, Maritime Exchange for the Delaware River and Bay
William R. Neil, Richard P. Kane, New Jersey Audubon Society
Alex Ogden, Delaware Bay Watermen's Association
William H. Palmer (Committee Vice-Chair), Robert O'Larnic, Water Resources Association of the Delaware River Basin
Gary Patterson, John Maxwell, Debbie Alford, Petroleum Councils
Cynthia Poten, Mary Ellen Noble, Tracy Carluccio, Watershed Association of the Delaware River
Barbara Rich, Judy Blum, Association of New Jersey Environmental Commissions
Jeanette Ross, Roberta Ehrenberg, Joyce Johnson, League of Women Voters Interleague Council of the Delaware River Basin



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James P. Scott, John Riley, American Waterworks Association
Bruce R. Walton, Shirley Steele, Jane Mitchell, Delaware Farm Bureau
Meghan Wren (Committee Co-Chair), Johanna Massey Biggs, Delaware Bay Schooner Project

In addition, a variety of individuals and organizations regularly participate in CAC meetings. These include:

William D. Angstadt, Delaware/Maryland Agribusiness Association
Marjorie A. Crofts, Staff Coordinator for CAC, DNREC
Karen S. Day, USFWS
Margaret Mints Ogden, Historian
Robert Nyman, USEPA Coordinator for CAC, USEPA, Region II
Dave Pollison, DRBC
Charles Rehm, PADER
Leah Roedel, Marion C. Stewart, National Recreation and Parks Association
Richard Seidel, Delaware Association of Conservation Districts

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Beth Matkins, Local Representative (City of Wilmington)

Kent County:

Kevin Coyle, County Representative

Sussex County:

Robert Davis, County Representative
Local Representative, Position Vacant

New Jersey

Burlington County:

Cindy Gilman, County Representative
Local Representative, Position Vacant

Camden County:

County Representative, Position Vacant
Robert Clark, Local Representative (City of Camden)

Cape May County:

James Smith, County Representative
Grover Webber, Local Representative (Cape May)

Cumberland County:

Jay Laubengeyer, County Representative
Mark Shuster, Local Representative (City of Bridgeton)

Gloucester County:

Rick Westergaard, County Representative
William Coughlin, Local Representative (Washington Township)

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Vitor Vicente, County Representative
Holly Fitzgerald, Local Representative
(Bensalem Township)

Delaware County:

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(Committee Chair)
Bruce Dorian, Local Representative (Borough of Marcus Hook)

Philadelphia County:

Stephanie Craighead, County Representative
Mark Brody, Local Representative (City of Philadelphia)

State Conservation Districts:

Richard Seidel, Delaware
Ferdows Ali, New Jersey
Malcolm Crooks, New Jersey
Robert E. Francis, Pennsylvania

Other Members

U.S. Coast Guard:

Mark Dougherty

Advisory Agencies:

Jeff Featherstone, DRBC
Barry Seymour, Delaware Valley Regional Planning Commission

Committee Staff:

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John Hines, PADER
James Walsh, PADER

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Marjorie A. Crofts, Staff for FPC, DNREC
Andrea Edwards, Office of Senator Lautenberg
Hon. David H. Ennis, Delaware General Assembly
Ronald K. Flory, PADER
Hon. Vincent J. Fumo, Pennsylvania State Senate
Richard Gore, DRBC
Steve Karlsen, DNREC
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Gary Patterson, Delaware Petroleum Council
John Flietz, Office of Rep. Weldon
Gerald J. Sabol, Office of Sen. Fumo
Ronald S. Tuminski, NJDEP

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Mark Botton, Fordham University
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Barbara Conlin, USACE
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Marjorie Crofts, DNREC
Joseph Davis
Joseph DiLorenzo, Najarian & Associates, Inc.
Eric Evenson, U.S. Geological Survey
Lloyd L. Falk
Deborah Freeman, USEPA, Region II
Jeffrey Frithsen, Versar, Inc.
Mary Downes Gastrich, NJDEP, Division of Science and Research
Jeff Gebert, USACE
Henry Gunther, Philadelphia Naval Shipyard
Bruce Halgren, NJDEP Division of Fish, Game and Wildlife
Scott Hall, Gloucester Co., Planning Department
Susan Halsey, NJDEP, Division of Science and Research
Steve Hammell, Delaware Estuary Program Office
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Stevens Heckscher, Natural Lands Trust
Mark Hermanson, Academy of Natural Sciences
Ward Hickman, U.S. Geological Survey
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Gregory Westfall, Soil Conservation Service
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Beth Matkins, City of Wilmington
Anthony Mitchell, Waste Trac
Ted Nash, Maritime Exchange
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Peter Himchak, NJDEP
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Karen Holm, Delaware County
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Nancy Jones, Delaware River Greenway
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Shirley Steele
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David Stout, USFWS (Chairman)
Ken Strait, PSE&G
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John Tyrawski, NJDEP
Phil Wallis, TNC
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Grover Webber, Cape May County
Anne Witt, NJDEP

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Kathy Clark, NJDEP
Robert Clark, CCMUA
Barbara Conlin, USACE
Joe Davis, Green Acres
Roy Denmark, USEPA, Region III
Helene Drago, USEPA, Region III
Lloyd Falk
Tom Fikslin, DRBC
Mary Gastrich, NJDEP
Laura Giese, ENTRIX, Inc.
Rick Greene, DNREC
Glenn Hanson, USEPA, Region III
Jerry Jameson, Bucks County
Susan Kilham, Drexel University
Mindy Lemoine, USEPA, Region III
Rick McCorkle, USFWS
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Alex Ogden, PBWA
Bob O'Larnic, Rohm & Hass
Jerry Pasquale, USACE
Dave Pollison, DRBC (Chairman)
Rob Ryan, PADEP
Dan Salvito, PSE&G
Richard Scrafford, City of Dover
Kathleen Stager, USEPA, Region III
Shirley Steele, Delaware Farm Bureau
Bob Tudor, DELEP Coordinator
Marria O'Malley Walsh, USEPA, Region III
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Meghan Wren, Delaware Bay Schooner Project

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Anne Witt, NJDEP

APPENDIX D

SUPPORTING PRODUCTS FOR THE CCMP

General Publications

Estuary News: The quarterly newsletter of the Delaware Estuary Program. First issue appeared in June 1990.

The Rising Tide: Bi-monthly newsletter of the Local Governments Committee. First issue, June 1990.

Program Directory: The Directory is a handbook which gives the names, addresses, and phone numbers of people and organizations represented on the Delaware Estuary Program's Policy and Management Committees and the Local Government, Scientific and Technical, Citizens, and Financial Planning Advisory Committees. February 1991 (being revised).

Media Handbook: A brief guide to preparing and distributing program information and generating media coverage. Features a directory of daily and weekly newspapers, radio, TV, plus a list of college environmental clubs. September 1991.

Public Access Guide: A handbook that pinpoints access sites in New Jersey, Pennsylvania, and Delaware that are open to the public. The book contains a series of 10 maps which indicate the locations of public access sites, recreational facilities, and historic and cultural places of interest. January 1993.

Fact Sheets:

"Why Keep Water Clean in the Delaware Estuary?"

"Will a Royal Dog Seafish Still Swim the Delaware Estuary?"

"A Bridge to the Future for the Delaware Estuary?"

"Why Conserve Water in the Delaware Estuary?"

"Animal Migration in the Delaware Estuary"

"Non-point Source Pollution in the Delaware Estuary"

"Toxic Contaminants in the Delaware Estuary"

"The Program to Protect and Preserve the Delaware Estuary"

"Birding in the Delaware Estuary"

"White and Red Clay Creek Demonstration Projects in the Delaware Estuary"

"Limulus Spawning Activity on the Delaware Bay Shores, May 1991".

"Will We Ever Restore the Delaware Estuary?"

The Delaware Estuary: Discover Its Secrets: A pamphlet explaining the Speakers Bureau of the Delaware Estuary Program and listing possible topic areas for programs.

The Delaware Estuary Program Progress Report 1988-1991: Produced by Andy Johnson, PA Environmental Council and Judy Blum, ANJEC. An overview of what has been done and an indication of the tasks that lie ahead for the Delaware Estuary Program.



Delaware Estuary Program Annual Report 1992: Produced by Andy Johnson, PA Environmental Council and Judy Blum, ANJEC.

Delaware Estuary Program Annual Report 1993: Produced by Andy Johnson, PA Environmental Council and Judy Blum, ANJEC.

Audio / Visuals

Crisis in the Delaware Estuary: Produced by Milner, Fenwick, Inc. 1969. A 20 minute video that gives information about the Estuary, its uses and ecology. Pollution problems and steps taken to address them are described.

The Delaware Estuary: Where the River Meets the Sea: Produced by Terra Communications, 1992. A seven minute educational video that shows the Delaware Estuary in all its beauty through myriad still life slides. The many resources and problems of the Estuary are discussed as are the Delaware Estuary Program and the goals of the Comprehensive Conservation and Management Plan.

Local Actions Regional Impacts: The Effects of Local Decisions on the Delaware Estuary: Produced by DVRPC/Terra Communications, 1992. A nine minute video describes the role of local governments and their involvement in the Delaware Estuary watershed.

Scientific / Technical Information

Recommendations for a Research Program Responsive to Management

Needs for Information to Ensure the Values and Uses Desired for the Delaware Estuary in 2020: By J.R. Schubel and William M. Eichbaum, Coast Institute of the Marine Sciences Research Center, October 1990.

Final Report: Delaware Estuary Program Land Use Management Inventory and Assessment: By Greeley-Polhemus Group, Inc., December 1990.

The State of the Delaware Estuary: Individual Papers from the October 19, 1989 Workshop, J.H. Sharp (Ed), 1991.

Inventory and Assessment of Historic Water Quality Data Sets; Part One: Status and Trend Analysis; Part Two: Annotated Bibliography: By Najarian Associates, May 1991.

Status and Trends of Toxic Pollutants in the Delaware Estuary: By Division of Environmental Research, Academy of Natural Sciences of Philadelphia, May 1991.

An Assessment of Key Biological Resources in the Delaware River Estuary and Appendices: By Versar, Inc., June 1991.

Habitat Status and Trends in the Delaware Estuary: By Dynamac Corp., September 1991.

Characterization Summary and Synthesis Report for the Delaware Estuary Program Preliminary Conservation and Management Plan: By Mary Downes Gastrich, New Jersey Department of Environmental Protection and Energy, January 1992.

SUPPORTING PRODUCTS

Nonpoint Source Pollution Control Phase I Strategy for Future Land Use in the Delaware Estuary: By Greeley-Polhemus Group, Inc., June 1992.

Delaware Estuary Monitoring Programs Inventory and Assessment: Roy F. Weston, Inc., July 1992.

History and Forecasts of Commodities and Vessel Traffic; Report of Task One of Comprehensive Analysis of Transport: By Jack Faucett Associates, July 1992.

An Assessment of Fisheries Landings Records in the Delaware Estuary: By K.A. Killam and W.A. Richkus, Versar, Inc., September 1992.

Projected Hazardous Spills in the Delaware River and Delaware Bay With and Without Channel Deepening: Report of Task Three of Comprehensive Analysis of Transport: By Jack Faucett Associates, October 1992.

Clean Water Works, Watershed Management Plan, Gloucester County, NJ, Planning Department: By Greeley-Polhemus Group, Inc., October 1992.

Clean Water Works, Water Resources Activity Guide, Grades K-12: By Gloucester, NJ Board of Chosen Freeholders, October 1992.

Delaware Estuary Regulatory Programs Inventory and Assessment: Roy F. Weston, Inc., October 1992.

Cumberland County, Delaware Estuary Study, Vol. I, Rare, Threatened and Endangered Species: By Herpetological Associates, Inc., October 1992.

Cumberland County, Delaware Estuary Study, Vol. III, Land Use Recommendations: By Board of Chosen Freeholders, October 1992, W.A. Richkus, Versar, Inc.

Assessment of Phytoplankton Species in the Delaware River Estuary: By H.G. Marshall, Old Dominion University, November 1992.

Red/White Clay Creek Demonstration Projects: Chester County Conservation District, November 1992.

Factors Limiting Primary Production in the Urban Delaware River: By J.G. Sanders and G.F. Riedel, the Academy of Natural Sciences, Benedict Estuarine Laboratory, December 1992.

Trace Element Speciation and Behavior in the Tidal Delaware River: By G.F. Riedel and J.G. Sanders, the Academy of Natural Sciences, Benedict Estuarine Research Laboratory, January 1993.

Assessment of Selected Delaware Estuary Economic and Natural Resources Values: By Greeley-Polhemus Group, Inc., January 1993.

Effects of Historic Dredging Activities and Water Diversions on the Tidal Regime and Salinity Distribution of the Delaware Estuary: Najarian Associates, February 1993.

Projected Vessel Casualties and Hazardous Spills in the Delaware River and Delaware Bay, 1990-2010: By Jack Faucett Associates, April 1993.

Survey of Benthos: Delaware Estuary: From the Area of the C&D Canal through Philadelphia and Trenton: By



Environmental Consulting Services, Inc., December 1993.

A Survey of Fish in the Delaware Estuary from the Area of the Chesapeake and Delaware Canal to Trenton: By John C. O'Herron, Thomas Lloyd and Kim Laidig, March 1, 1994. DELEP Report #94-01.

Regional Information Management Service, (RIMS) Data Management Plan: By American Management Systems, Inc., May 1994. DELEP Report #94-02.

History of the Human Ecology of the Delaware Estuary: By Jonathan Berger, John Walter Sinton, John Radke, April 27, 1994. DELEP Report #94-03.

Land Use and Nonpoint Pollution Study of the Delaware River Basin: By Penn State Environmental Resources Research Institute, March 1994. DELEP Report #94-04.

Land Use Management and NPS Control for the Delaware Estuary: The Pennsylvania Project: By the Greeley-Polhemus Group, June 1994. DELEP Report #94-05.

Pennsylvania Demonstration Project: Guidance for Voluntary Local Government Orientation of NPS Control Protecting Local Streams and the Delaware Estuary: By Greeley-Polhemus Group, Inc., June 1994. DELEP Report #94-05A.

Status and Trends of the Delaware Estuary Watershed: By the Delaware Valley Regional Planning Commission, June 1994. DELEP Report #94-06.

Fish Consumption Patterns of Delaware Recreational Fishermen and Their Households: By David C. Cox & Associates, April 13, 1994. DELEP Report #94-07.

Distributions of Chemical Contaminants and Acute Toxicity in Delaware Estuary Sediments: By Arthur D. Little, Inc., June 4, 1994. DELEP Report #94-08.

Delaware Estuary Program Regional Monitoring Plan and Appendices, 2 Vols.: by Tetra Tech, Inc., September 1994. DELEP Report #94-09.

APPENDIX E

DELAWARE ESTUARY PROGRAM PRIORITY SPECIES LIST

AQUATIC INVERTEBRATES

Jellyfish
Copepods
Small Decapods
Saltmarsh Invertebrates
Soft (mud/sand) Bottom Oligohaline/Fresh Community
Soft (mud/sand) Bottom Polyhaline Community
Hard Bottom Polyhaline Community
American Oyster
Mysid Shrimp
Horseshoe Crab
Blue Crab
Dragonflies
Saltmarsh Mosquito

FISH

American Shad
River Herrings
Marine Forage Fish
Freshwater Marsh Killifishes
Brackish Marsh Killifishes
Drums
Structure Oriented Fishes
Catfishes
Carp
Minnows
Sunfish, Centrarchids and Esocides
Sturgeons
American Eel
Atlantic Menhaden
Weakfish
Sharks, Skates, and Rays
Perch
Striped Bass
Flounder
Bluefish
Important Biomass Fish



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HERPTILES

Diamondback Terrapin
Vernal Pond Breeders
Marsh Turtles
Sea Turtles

BIRDS

Migratory and Non-tidal Pond Shorebirds
Willet
Northern Harrier
Short-eared Owl
Barn Owl
Bald Eagle
Osprey
Herons and Egrets
American Black Duck
Northern Pintail, Mallard, Green-winged Teal
Snow and Canada Geese
Sea/Bay Ducks
Swamp/Forest Nesters
Laughing Gull
Marsh Wren and Coastal Plain Swamp Sparrow
Saltmarsh Sparrows
Rails
American Woodcock
Migratory Passerines
Migratory Raptors
Bitterns

MAMMALS

River Otter
Muskrat
Bats
Marsh Rice Rat
Meadow Vole
Marine Mammals
Beaver
White-tail Deer

PLANT COMMUNITIES/HABITATS

Natural Communities

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APPENDIX G

FINANCIAL PLANNING FOR THE DELEP COMPREHENSIVE CONSERVATION & MANAGEMENT PLAN

I. INTRODUCTION

A. Why a Financial Plan

The National Estuary Program provides funding for the development of Comprehensive Conservation and Management Plans (CCMPs) under Section 320 of the Clean Water Act, but does not provide funding for the implementation of the plans. Without a strategy for funding the implementation of the Delaware Estuary Program's CCMP, it runs the risk of turning into a shelf-document instead of a guide to managing the natural resources of the Delaware Estuary.

The Delaware Estuary Financial Plan contains two necessary components: a fund-raising organization (Section II) and options for funding individual CCMP recommendations (Sections III-VII). The fund-raising organization, called the Delaware Estuary Foundation, is necessary to ensure that the plan maintains a high profile in the public arena. However, the Delaware Estuary Foundation will not be able to fund all of the CCMP's recommendations. On the same note, funding for individual CCMP recommendations may not be pursued unless an organization has been designated to conduct that function.

The options for funding individual CCMP recommendations include a number of components: redirection of current state and federal programs; local and regional private foundations; public/private partnerships; fees for services; federal legislation; and economic development funds from regional authorities. Each of these components is explained in this Appendix.

B. Financial Planning Committee

The Financial Planning Committee was established by the Delaware Estuary Program in October 1990 for the purpose of proposing financing plans for the implementation of the Program's CCMP. A list of Financial Planning Committee members is contained in Appendix C. The Financial Planning Committee prepared this Appendix of the CCMP.

C. Overview of Financing Options Not Considered

Very early in its deliberations, the Financial Planning Committee decided not to propose new general taxes, such as a gas tax, that would be dedicated to the implementation of the Delaware Estuary CCMP. The Committee felt that the citizens



of the three states bordering the Delaware Estuary were already under a significant tax burden which should not be increased. More importantly, the Committee felt that there was both substantial interest in the estuary to support the implementation of the CCMP through a combination of donations, appropriations, and focusing existing resources on the Delaware Estuary. The latter option is not intended to diminish the funding of any existing program but to focus the financial and human resources available to fulfill the requirements of the priority programs of the Delaware Estuary (see Section III).

Although general taxes were not considered, user fees are considered an option for implementing certain CCMP recommendations. All proposed user fees are intended to be paid only by those who require the service and the funds will only be used to provide the service.

II. DELAWARE ESTUARY FOUNDATION

A. Description

The Delaware Estuary Foundation is an incorporated public charity whose function is to promote and coordinate the implementation of the Delaware Estuary Comprehensive Conservation and Management Plan. The Foundation will be governed by a board composed of representatives from user groups of the Delaware Estuary. For a complete description of the Delaware Estuary Foundation, see Chapter XI, Implementing the CCMP.

B. How it is Funded

For the first three years it is estimated that the Foundation will receive \$300,000 from the U.S. Environmental Protection Agency under Section 320 of the Water Quality Act Amendments of 1987. These funds are designated for administering CCMP implementation and will be available from October 1995 to September 1998.

It is the recommendation of the Financial Planning Committee that the States of Delaware, New Jersey, and Pennsylvania appropriate \$300,000 to the Delaware Estuary Foundation and maintain a state coordinator position for fiscal years 1996 through 1998.

The CCMP implementation grants available from the U.S. Environmental Protection Agency require a twenty-five percent non-federal match. There is no requirement that this match come from the states or that the match be cash. In order to fund the basic administrative costs of the Delaware Estuary Foundation, the States of Delaware, New Jersey, and Pennsylvania should commit to providing \$100,000 in cash each for fiscal year 1996, 1997, and 1998 to the Delaware Estuary Foundation and assign one staff position to coordinate state activities with the Foundation. The staff position will be an additional cost to the states ranging anywhere from \$50,000 to \$100,000

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depending on pay scales, benefit packages, and overhead costs. The source of these funds should be left up to the individual states. The Foundation and the states should evaluate the need to continue this support for additional years. The combination of Section 320 funds and state appropriations will give the Foundation an annual operating budget of \$600,000.

It is the recommendation of the Financial Planning Committee that hiring a Development Director be a priority for the Delaware Estuary Foundation.

The Delaware Estuary Foundation will be using its operating budget to hire staff, including an Executive Director and an Administrative Assistant. Although both of these positions will be involved in fund-raising, it is important for the Foundation to dedicate a full-time position to fund-raising in its formative years to ensure the success of the organization. This position, called a Development Director, should be added to the Foundation staff in 1995. The Development Director would be responsible for implementing the financial strategies identified in this chapter to support the activities of the Delaware Estuary Foundation. The Development Director would also be responsible for developing proposals and negotiating agreements to fund the implementation of individual CCMP recommendations. The proposals would be submitted to federal, regional, and state agency programs, identified in Section III of this chapter, and corporations and private foundations. These proposals could be submitted by the Delaware Estuary Council or any organization approved by the Council. The Development Director would also assist in negotiations to establish partnerships (see Section IV), negotiate with the Delaware River and Bay Authority for Economic Development Project funding (see Section VII), work with the states and Congress for the redirection of penalties (see Section VI), and assist local governments in establishing fees for services (see Section V).

It is the recommendation of the Financial Planning Committee that the Delaware River and Bay Authority and the Delaware River Port Authority form a partnership with the Foundation for the purpose of implementing the Delaware Estuary Comprehensive Conservation and Management Plan. The partnership should involve either an annual donation to the Foundation or the implementation of one or more CCMP recommendations on an annual basis.

The Executive Director and the Development Director should work with the Delaware River and Bay Authority, the Delaware River Port Authority, and the three state General Assemblies to determine the feasibility of having the two agencies provide financial support to the Delaware Estuary Foundation. In addition, the Delaware Estuary Foundation should work with these and other public and private entities to implement specific CCMP recommendations. See Section IV for further details.



It is the recommendation of the Financial Planning Committee that the States of Delaware, Pennsylvania, and New Jersey issue a Delaware Estuary License Plate, proceeds of which would be dedicated to the Delaware Estuary Foundation.

The States of Delaware, New Jersey, and Pennsylvania should issue a Delaware Estuary License Plate, the proceeds of which would go to the Delaware Estuary Foundation. The Delaware Estuary License Plate should be offered to motorists in the State of Delaware; Bucks, Philadelphia, Delaware, and Chester Counties in Pennsylvania; and Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, and Salem Counties in New Jersey. The cost of these plates would equal the cost to produce and issue them plus a \$20 donation for the Council. The portion of the fee that covers production and issuance costs would go the appropriate state agency. Individuals who purchased the plates would be able to declare the donation portion as a tax exemption. The states may also consider placing a \$500 fee for the first one hundred plate numbers, \$475 of which would go to the Delaware Estuary Foundation and would be tax-exempt. The proceeds from license plate sales could be substituted for an equal portion of a state's annual appropriation to the Foundation.

It is estimated that one percent of the population would purchase Delaware Estuary license plates. Using the one percent estimate, funds raised through the license plate program would generate \$140,000 in Delaware, \$350,440 in New Jersey, and \$534,860 in Pennsylvania.

It is the recommendation of the Financial Planning Committee that the States of Delaware and New Jersey and the Commonwealth of Pennsylvania work with local legislators to incorporate support of the Delaware Estuary Foundation into development opportunities as appropriate.

The States of Delaware and New Jersey and the Commonwealth of Pennsylvania actively promote the location of new industries into their respective states. When new development opportunities have a direct relation to the Delaware Estuary, the states should encourage the principals of the project to support the Delaware Estuary Foundation. Support could take the form of donations, implementation of individual Management Plan recommendations, allocation of display space to the Foundation, merchandising partnerships, use of Delaware Estuary themes in advertisements, and any other activities considered beneficial to the Delaware Estuary as determined by the Delaware Estuary Foundation and the development principals.

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation be formed as a membership organization.

The Delaware Estuary Program currently has over 13,000 individuals on its mailing list. The Financial Planning Committee estimates that 20 percent of the Delaware Estuary Program's mailing list would be willing to pay a \$20 annual membership fee, resulting in \$52,000 in receipts.

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation should actively solicit corporate memberships and donations from regional corporations.

The Foundation's Development Director should actively solicit corporate donations. These donations should come through annual corporate membership fees and/or one-time donations. Corporate membership fees should be set in a range from \$1,000 for small businesses to \$10,000 for large corporations. The funds raised from corporate membership fees would be allocated at the direction of the Foundation's Board of Directors. One-time donations would be targeted by the contributing corporation to individual activities that the Foundation wants to conduct and may be in the form of cash, services, or supplies/materials. The Financial Planning Committee has identified over 190 corporations that are either considered one of the major employers in the Delaware Estuary region or have a permit to discharge into the Delaware Estuary or one of its tributaries. If each of these companies gave a minimum donation of \$1,000 per year, \$190,000 per year could be raised for the Foundation. This is a reasonable target figure as some corporations will not donate while others will donate more than the minimum.

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation enter into merchandising partnerships with regional manufacturers for the purpose of raising both funds and awareness.

In addition to requesting membership fees and one-time donations to the Foundation, the Foundation's Development Director should encourage merchandising partnerships with regional manufacturers. These partnerships would involve having a portion of the sales in general or of specific items donated to the Foundation. Examples of merchandising partnerships are credit cards that donate a portion of all sales to the Foundation, banks that donate a set amount for every check written by its customers (which was done for the Puget Sound by the Puget Sound Bank), and the Anheuser-Busch beer stein that was offered for sale in the Chesapeake Bay region. The stein featured a scene from the Chesapeake Bay and \$1 from the sale of each stein was contributed to the Chesapeake Bay Trust with a guarantee of a minimum of \$13,000. The Foundation should attempt to execute merchandising partnership agreements that would net at least \$10,000 each.

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation conduct fund-raising events for the purpose of raising both funds and awareness.

The Foundation should conduct at least four fund-raising events per year with the goal of raising \$40,000 annually. Ideas for fund-raisers include, but are not limited to, athletic competitions, sponsored walks (i.e., Walk for Water), ferry cruises, festivals, silent auctions, estuary dinners, and tournaments (i.e., golf, fishing).



It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation sell Delaware Estuary merchandise for the purpose of raising both funds and awareness.

The Foundation should develop and sell Delaware Estuary merchandise, such as a Delaware Estuary print and associated stamp (similar to waterfowl stamps), t-shirts, baseball caps, pens, note pads, bumper stickers, calendars, mugs, etc. The Foundation should attempt to raise \$5,000 to \$10,000 annually through the sale of merchandise. Receipts from merchandise sales would be increased if the Foundation's Development Director can arrange for the donation of the merchandise and/or the printing.

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Program actively solicit funding for the implementation of individual CCMP recommendations from private foundations.

Private foundations may also be a source of project specific funding for the Foundation. There are 250 private foundations which support environmental programs listed in the "Environmental Grantmaking Foundations 1992 Directory" and the Financial Planning Committee has identified 81 foundations that have a particular interest in funding activities in the Delaware Estuary region. Although many foundations will not fund general administrative and operating expenses, the Foundation could apply for foundation funding to conduct educational programs and public events; print brochures, guides, and reports; and support demonstration projects, construction, and research projects. The Foundation should solicit private foundation funding both for its own projects and on behalf of a third party whose proposal the Foundation supports.

The Foundation may also benefit from two additional sources of funds that cannot be used to estimate future income: endowments and court directed penalties. Both of these sources of funds would most likely be rare and may have limitations on their use. Endowments would come from individuals or their estates that support the activities of the Foundation. Penalties would result from a fine placed on an organization by local, state, or federal regulators for a pollution event. Generally, fines levied against violators go back to the government that levied the fine. However, it is becoming more common to have all or a portion of the fine given to a third party either by the regulatory agency or under an agreement between the regulatory agency and the violator. The Delaware Estuary Foundation will not have standing to bring suit against another party for violations of environmental statutes.

C. What it Will Fund and How

The Delaware Estuary Foundation should keep its administrative expenses to \$450,000 per year. Approximately \$300,000 should be used for salaries and

expenses and \$150,000 for public education and involvement activities (see Education and Involvement, Chapter VII).

Any funds available through the Delaware Estuary Foundation in excess of \$450,000 should be used to fund the implementation of the Comprehensive Conservation and Management Plan. Each year the Foundation should estimate the amount available for CCMP implementation and select recommendations for funding priority. The Council may determine that its staff is best suited to implement a recommendation and can appropriate additional funds to its administrative expenses for this purpose. If the Foundation determines that there is an existing public agency that is most appropriate to implement a particular recommendation, the Foundation should execute a Memorandum of Understanding with that agency. For those CCMP recommendations where no appropriate agency is identified for implementation, the Foundation should advertise a request for qualifications through the Business Commerce Daily and the Foundation's mailing list. A contract to implement the recommendation(s) should be executed with the most qualified and cost effective applicant(s). The Foundation should not consider funding unsolicited proposals or actions that are not recommended by the CCMP or in revisions to the CCMP.

D. What Needs to be Done to Establish the Delaware Estuary Foundation

It is the recommendation of the Financial Planning Committee that the Delaware Estuary Foundation be established and the Foundation's Program Director hired by 30 May 1995.

Setting up a public charity involves fulfilling both state and federal legal requirements. Each of these requirements is described in "Recommendations for an Institutional Framework for the Financial Management and Implementation of the Delaware Estuary Program's CCMP" (September 1993) by Apogee Research, Inc. In summary, these requirements are:

- * Select a Corporate Name
- * Draft the Bylaws and Certificate of Incorporation
 - Provisions for the initial appointment of the Board of Directors and the future manner of their selection
 - Provisions for revision of bylaws and/or certificate of incorporation
 - A statement of purpose for the corporation
 - Provisions for the fate of the corporation's assets in the event of dissolution
 - Provisions for membership by private citizens, and voting rights of members
 - Provisions for avoiding conflicts of interest by Board members who are representatives from regulatory agencies
- * Retain a Registered Agency in Delaware, if Necessary
- * File Certificate of Incorporation with the Delaware Secretary of State
- * Register to Do Business in Pennsylvania and New Jersey



- * Register to Solicit for Charitable Contributions in Pennsylvania and New Jersey
- * Submit IRS Form 1023 with Accompanying Documentation

In addition to the legal requirements, office space will have to be found, supplies and equipment purchased, and Foundation staff hired.

III. REDIRECTION OF CURRENT PROGRAMS

Funds to implement a variety of environmental programs is appropriated by federal and state agencies and other organizations every year. These funds are generally allocated to an issue (i.e., point source pollution control, wetlands enhancement, education) and not to a specific geographic area. Over 140 programs have been identified that could be used to implement most of the Delaware Estuary Program's Comprehensive Conservation and Management Plan recommendations. Some of these programs provide funds in the form of grants, loans, or cost-sharing, while others provide technical assistance, information, or conduct research on behalf of the requesting party. The matrix (Table 1) links individual CCMP recommendations to existing programs.

It is the recommendation of the Financial Planning Committee that all state and federal agencies give special consideration to funding the implementation of CCMP recommendations under all programs listed on Table 1. In addition, consistency with the CCMP should be made a requirement for all projects subject to the State Clearing House process.

Special consideration status for funding CCMP recommendations through existing programs should be negotiated by the Delaware Estuary Foundation. State agencies can assign program priorities to its administrators. Federal agencies can do the same and make implementation of CCMP recommendations a requirement under their various grant programs. In most cases, the funds generated through these programs will be allocated from the administering agency directly to the agency/organization that will implement the appropriate CCMP recommendations. In these cases, the funds will not be passed through the Delaware Estuary Foundation.

Table 1. Existing funding sources matrix.

AGENCY/PROGRAM	RELATED CCMP RECOMMENDATIONS
COMMONWEALTH OF PENNSYLVANIA PROGRAMS	
Environmental Education Fund @	T2, E2, E4, E5, E6, E7, E13, E19
Keystone Recreation, Park & Conservation Fund \$	L4, L6, L18, W11.1-4, H5, H7, E3, E4, E5, E6, E7, E20, E22
PennSERVE @	L1, L4, L5, L17.1 T2.1-2, E2, E3, E4, E5, E6, E7, E11, E12, E13, E16, E18, E19, E22
PENNVEST #	L3, L5, L10, L16.1, W4.1, W5, W7, W12, T5.3
Wild Resource Conservation Fund \$	L14, H1, H2, H3, H4, H5, H6, H7, H8, E2, E6, E12, E15, E16, E17
DHHS/PUBLIC HEALTH SERVICE PROGRAMS	
Public Health Assessments & Related Site-Specific Biological Testing @	T6.4, T6.5, T6.6
Surveillance of the Relationship Between Hazardous Substances @	T6.4, T6.5, T6.6
DOC/EDA PROGRAMS	
Economic Development, Public Works, Development Facilities @	L17.1, W1, W4, T5.3
DOC/NOAA PROGRAMS	
Coastal Ocean Program Mapping Effort +	L14, H8
Coastal Wetlands Inventory +	L2.1, L2.2, L14.2, H3.2, H8
Coastal Zone Management Program @	All Action Items
Cumulative Effects of Multiple Stressors on Coastal Ecosystems @	T4.4-8, T5.1-3, T6.3-6



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Electronic Information Services +	L2.1, L2.2, L14.2, H3.2, H8
Financial Assistance for Ocean Resources Conservation & Assessment Program @	T1, T4.4-5, T5.1-3, T6.5-6, M4, M5, M6
Fisheries Development & Utilization Research & Development Program @	H1.1, H1.2, H3.3, H5.4, H5.7, H8, T6.5, T6.6, T6.7
GeoCoast +	L2.1, L2.2, L14.2, H3.2, H8, R2
Marine Fish Habitat Restoration & Creation Program +	H5, H7, W8.4
National Estuarine Inventory +	L14, H8
National Estuarine Research Reserve System @	H5, H7, E4, M5, M6
NOS Partnership Proposals @	L1, L2.1-4, L3, L4, L5.1-4, L14.2-3, L11, W8.1-4, H1.1-2, H3.1-3, H4.1-8, H5.1-8, H6, H7.1-3, T4.4-5, T5.1-2, T6.3-7, R2, M3, M4, M5, M6
Sea Grant Support @	W8.1, W8.3, W8.4, W10, W11.1-3, W12, W13.1-2, H1, H2, H3, H4, H5, H6, H7, H8, T4.5, T5.1, T6.3-7, E2, E6, E7, E8, E10, E11, E12, E15, E16, E13, E18, E14
Strategic Environmental Assessments +	L2.1-2, L14.2, W3, W8.3, W8.4, H3.1-3, H8, T1, T4.4, T4.5, T5.1-2, T6.5, M3, M6
DOD PROGRAMS	
Legacy Resource Management Program @	L2, L3, L4, L5, L6, L14, W10, H1, H2, H3, H4, H5, H6, H7, H8, H9
DOI/BLM PROGRAMS	
Wildlife Challenge Cost Share @	H3, H5, H8, L14
DOI/FWS PROGRAMS	
Anadromous Fish Conservation @	H3, H5

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Aquatic Resources Education \$	E2, E6, E12
Bay/Estuary Program +	L4, L5, L7, L13, L14, W8.3, W8.4, W10, H1, H2, H3, H4, H5, H6, H7, H8, H9, T1, T6.1-7, E2, E6, E7, E11, E12, E15, E13, E20, E14, E22, M4, M5, M6, R2
Biomonitoring of Environmental Status & Trends +	T5.3, T6.5, M4, M5, M6
Challenge Cost Share Program @	L6, H5
Coastal Wetlands Planning Protection and Restoration @	L6, H5
Conservation Law Enforcement Training & Assistance +	H4.3
Endangered Species Conservation @	L6, H1, H2, H3, H4, H5, H8, E6, E12
Environmental Contaminants +	T4.4, T5.1, T6.5
Fish & Wildlife Management Assistance +	H1, H2, H3, H4, H5, H6, H8, T5, T6.5
Migratory Bird Conservation Fund \$	L6
National Coastal Wetlands Conservation Grants @	L4, L6, W8.4, H4, H5, H7, E4, E6
National Wetlands Inventory +	L14, H3, H8
National Wetlands Research Center +	L2.1-2, L14.2, H3.2, H8, R2, M3
North American Wetlands Conservation Act @	L6, H4.4, H5.3, H7.2
Partners for Wildlife - Private Lands Initiative @ +	L4, L6, H5, H7
Pumpout Grant Program @	W12, T2.3, E2, E4, E7



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Sport Fish Restoration @	L4, L6, W11.1, W11.2, W11.4, H1, H2, H4, H5, H6, H7, H8, H9, T6, E2, E6, E14, E22
Wildlife Research Information +	H3, T5.1-3, T6.5
Wildlife Restoration @	L4, L6, W8.2, W11.4, H1, H2, H3, H4, H5, H6, H7, H8, T6.5
DOI/NPS PROGRAMS	
Land & Water Conservation Fund @	L6
National Natural Landmarks Program +	
National Wild & Scenic Rivers Program +	L4, L5.4
Rivers, Trails & Conservation Program +	L4, L5.4, L6, W11.4
Urban Park and Recreation Recovery Program \$	L6, W16.2
Wetlands Goals and Guidelines @ +	L6, H5, E6, E12, E22, M4, M5, M6
DOI/USGS PROGRAMS	
Federal State Cooperative Program + *	W3, T1, M4, M5
Geologic Division +	L2.1-2, L14.2, H3.2, H8, R2, M3
National Mapping Program +	L2.1-2, L14.3, H3.2, H8, W8.4, R2, M3
National Water Information System +	L14, W3, W5, E5, R2
National Water Quality Assessment Program +	T1, M4, M5, M6
National Water Resources Research Program @	W3, T4.4, T5.2-3, T6.5, M4, M5, M6
Water Data Program +	W3
Water Research Institute Program @	L2, L3, W3, W5, W6, W10, T4.4, T5.3, T6.5, M4, M5, M6

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DOT PROGRAMS	
Development & Promotion of Ports & Intermodal Transportation @ +	W9, W10
Oil Pollution Research and Development Program @ +	W9, W10, H8, T5.2-4
DUCKS UNLIMITED	
Habitat USA +	H5
Matching Aid to Restore States Habitat @ *	L6, H5, H7
Habitat Inventory and Evaluation +	L14, H3, H5
EPA PROGRAMS	
Advanced Identification of Natural Areas, Section 404 +	L14, H8
Assessment & Watershed Protection Support @	L2, L3, L7, L10, L11, L14, W3, H4, T4.4
Brownfields Economic Redevelopment Initiative @	L17.1-2
Clean Lakes Program, Section 314 @	L2, L3, L4, L5, L14, H5, E11, E18, E23, T5.2-4
CSO Abatement Projects @	T5.4, W13.2-3
Environmental Justice Small Grants @	L1, L4, L5.1-4, L6, L12, L13, L14.2, L14.3, L17.1-2, W5, W11.3-4, W12, W13.1, T2.1, T2.3, T4.4-5, T6.7, E2, E4, E5, E7, E11, E12, E16, E17, E18, E19, E20, E23, R2, M6
Environmental Monitoring & Assessment Program +	L14, H8, T1, T4.4, T5.3, T6.5, M4, M5, M6
Environmental Technology Initiative * +	T2.3, T5.3, R2
Hazardous Substance Response Trust Fund (Superfund) @	L17



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National Estuary Program @	L7, L10, L11, L13, L16, L17, W1, W2, W4, W5, W6, W7, W8, W9, W10, W11, W13.1-2, W14, H1, H2, H4, H6, H9, H10, T1, T3.1-3, T4.1-7, T5.1-4, T6.1-7, All Education Recommendations
National Environmental Education Act @	L2, L13, E2, E3, E4, E5, E6, E7, E11, E13, E14, E16, E17, E18, E19, E22, E23
National Pollutant Discharge Elimination System Related Grants \$	L2, L3, L5, T2.3, T3.1-3, T4.1-7
Near Coastal Waters @	L3, L4, L5.1-4, W3, W5, W6, W8.1-4, H4.1-8, H5.1-8, H7.1-3, T1, T3.1-3, T4.1-8, T5.1-3, T6.3-7, R2, M4, M5, M6
Nonpoint Source Implementation, Section 319 @	L2, L3, L5, L13, W17, T2, T4.4, T5.4, T6.6, E2, E4, E5, E6, E7, E12, E18, E14, E22
Pesticide Programs \$	T2.1-2, T5.4, T6.6-7, E7
Pollution Prevention Incentives for States @	W5, T2.1-3, E5, E7
State Public Water System Supervision @	W1, W2, W4.1, W4.2, W6, W7
Strategic Environmental Research & Development Program @	W5, H5, H7, H9, T2, T5.4, T6, M5, M6
Wastewater Operator Training Program, Section 104(g)(1) @	T2.3
Water Pollution Control Section 106 @	L7, L8.1-2, L10, L14, W5, W8, H9, T1, T2.1-3, T3.1-3, T4.1-8, T5.1-4, T6.1-7, E11, E18, M3, M4, M5, M6
Water Quality Cooperative Agreements, Section 104(b)(3) @	L2, L3, L4, L5, L7, L9, L11, L14, W10, H3, H4, H5, H7, H8, H9, T3.1-3, T4.1-8, T5.1-4
Water Quality Management Planning, Section 604(b) {old 205(j)} @	L2, L7, L10, W5, W10, H4, H8, H9, T4.1-8, T5.1-4
Wetlands Protection Program @	H4

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NORTH AMERICAN WETLANDS CONSERVATION COUNCIL @ *	L6, H5
STATE OF DELAWARE PROGRAMS	
Aglands Preservation & Conservation Easement Program \$	L6
Conservation Cost Share Program *	L3, L4, L5, H5
Delaware Land and Water Conservation Trust Fund \$	L4, L6, W16, H5
Delaware State Arts Council \$	E15
Duck Stamp Program \$	L5.3, H1.1-2, H2.2, H3.1-3, H4.1-7, H5.1, H5.3, H7.1-3, H8
First State Resource Conservation & Development Council \$ +	L1, L2, L3, L11, L13, L16.1-2, T2.1-3, E2, E3, E6, E11, E12, E16, E17, E15, E13, E18, E20, E23
State Revolving Fund #	L3, L5, L16.1, W5, W11.4, W12, H5, H7, T2.1-2, T5.5
STATE OF NEW JERSEY PROGRAMS	
Environmental Endowment for New Jersey @	L1, L2.2, L2.3, L4.1-4, L5, L6, L8.1-2, L13, L14.2, L16.3, L17.1, W8.1-4, W12, W13.1-3, H3.1-3, H4.1-7, H5.1-8, H7.1-3, H8, T1, T2.1-3, T4.5, T5.1-2, T6.5-7, T4.4, All Education Recommendations
Municipal Stormwater Management & Combined Sewer Overflow Abatement Assistance Fund #	L2, L3, L5, L14, T5.4
National and Community Service @	L1, L4, L5, L17.1, T2.1-2, E2, E3, E4, E5, E6, E7, E11, E16, E18, E19, E22, R2
New Jersey Green Acres \$	L4, L6, W11.4, H5
New Jersey Green Trust @#	L4, L6, W11.4, H5
New Jersey State Council on the Arts \$	E15



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New Jersey Wastewater Treatment Fund #	L16.1, W5, T5.3
New Jersey Wastewater Treatment Trust #	L16.1, W5, T5.3
New Jersey Waterfowl Stamps \$	L4, L6, H1, H2, H3, H4, H5, H7, H8, E6
Open Space Preservation Bond Act of 1989 \$	L4, L6, W11.4, H5
Water Supply Rehabilitation Loans #	W1, W4
Water Supply Replacement Loans #	
USACE PROGRAMS	
Aquatic Plant Control + *	H5
Beach Erosion Control + *	H7
Environmental Initiatives Program *	H5, H7
Flood Control Projects + *	L2, L3
Flood Plain Management Services +	L2, L3
Navigation Projects + *	W8.1-2
Planning Assistance to States @ +	L2, L3, L5, W5
Snagging and Clearing for Flood Control + *	H5
Special Area Management Plans *	L4, L5.1-4, H4.4-5, H5.1-8, H7.3
Wetlands Research Program +	L5.1-3, L2.1-2, H4.1-2, H4.6, H5.3, H7.2
USDA/ASCS PROGRAMS	
Agricultural Conservation Program \$	L2, L3, L4, H5, H7, T2.2
Conservation Reserve Program \$	L4

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Rural Clean Water Program \$	L2, L3, T2.2
Water Bank Program \$ +	H5
Water Quality Incentives Program \$	L2, L3, L4, H5, H7, T2.2, T5.3
Water Quality Special Projects * +	L2, L3, L4, H5, T2.2, T5.2-3
Wetlands Reserve Program \$	H5
USDA/FmHA PROGRAMS	
Emergency Community Water Assistance Grant @	W4.1, W4.2, W7
Distance Learning & Medical Link Grants @	L14.3, E16, R2
Primary Loan Service Program (Conservation Easement Program) #	L6, H5, H7
Resource Conservation and Development Loans #	L2, L3, L4, L5, W4.1, W11.4, H5, T2.2, T5.3
Technical Assistance & Training Grants @	W4.1, W4.2, W5, W6, W7
Soil and Water Loans #	L2, L3, L4
Solid Waste Management Grants @	T2.1, T4.4
Water & Waste Disposal Systems for Rural Communities @#	L16.1 W4.1, W4.2, W5
Watershed Protection & Flood Prevention Loans #	W4.1, W4.2
USDA/FS PROGRAMS	
Challenge Cost-Share Program @	
Cooperative Forestry Assistance @	L4, H5
Forest Legacy Program \$	L4, L6



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Forest Stewardship Program + @	L4, L6
Forestry Research @	
Stewardship Incentives Program *	L4, L6, H5, H7
Urban and Community Forestry @ +	L4, H7, E4, E6
USDA/SCS PROGRAMS	
Farm*A*System +	L2, L3, T2.2, T4.4, T5.4, M4, M5, M6
Resource Conservation and Development Program @ +	L2, L3, L5, L6, W5
Snow Survey & Water Supply Forecasting +	W3
Soil Survey +	L14, H3
Soil & Water Conservation +	L3, L4, L5.1-4, W5, H4.5, T2.2, T4.5
Watershed Protection & Flood	
Prevention Act (PL 83-566) @ +	L2, L3, L4, L5, L7, W5, H5, H7, T2.2, T5.2-3

KEY: @ Grant Programs
 # Loan Programs
 * Cost Share Programs
 + Technical Assistance, Informational Services or Research Assistance
 \$ Direct Payments

One federal program that is not currently being used to its maximum potential is the State Revolving Fund Program. Established by the Water Quality Act Amendments of 1987, this program makes capitalization grants to states to create revolving funds. The purpose of these revolving funds is to provide financial assistance to local communities for water quality projects and activities. The primary focus of revolving funds is financing local wastewater treatment facilities. The Act also states that revolving funds can be used to finance the implementation of nonpoint source plans, wetland programs, and estuary Comprehensive Conservation and Management Plans.

Any project or activity included in a CCMP that has been approved by the appropriate Governor(s) and the USEPA Administrator is eligible for assistance under the State Revolving Fund Program. These could include wetlands and living resources restoration, nonpoint source control programs, and construction of capital facilities

such as treatment plants or stormwater retention basins. Other types of clean-up projects, those that are capital intensive with a user base to support payments, are well suited to State Revolving Fund financing.

In order for projects to be funded using the State Revolving Fund Program, they must be included on the states' Project Priority List (PPL). The PPL is a list of all the projects eligible for State Revolving Fund funding. This list is typically revised every five years and requires a public hearing. From the PPL, an Intended Use Plan (IUP) is generated. The IUP describes how much money the state has and how it will be spent.

It is the recommendation of the Financial Planning Committee that the States of Delaware, New Jersey, and Pennsylvania should revise the criteria for eligible activities under their state revolving funds to include eligibility for all activities included in the Delaware Estuary's Comprehensive Conservation and Management Plan.

The state revolving funds in the three states are: State Revolving Fund (Delaware), New Jersey Wastewater Treatment Fund and Trust (New Jersey), and PENNVEST (Pennsylvania). The Delaware fund does finance nonpoint source control project and PENNVEST finances stormwater control projects in addition to wastewater treatment facilities. However, none of the three states' funds include the implementation of Comprehensive Conservation and Management Plans as eligible activities for financial assistance.

IV. PUBLIC/PRIVATE AND PUBLIC/PUBLIC PARTNERSHIPS

Public/private partnerships are agreements between public and private entities to work together to meet some environmental need. Examples of such partnerships include the privatization of a public utility, private funding for public programs, joint public/private funding for a project benefiting both parties, and allowing the use of public property by a private interest in exchange for having the private interest provide a public service. Public/public partnerships are agreements between a public agency and a public authority, such as a port or solid waste authority, and work in the same way as public/private partnerships.

The Delaware Estuary Program has been successful in establishing three public/private partnerships to date. One company funded the printing of the Program's bumper sticker and loaned the Program audio/visual equipment; the Public Service Electric and Gas Company designed and sponsored a series of newspaper advertisements on behalf of the Program; and radio station WSTW and the Public Service Electric and Gas Company sponsored the Delaware Estuary Program tent at the 1994 Delaware River Days event. The Program has not established any public/public partnerships.

The Delaware Estuary Foundation, the states, local governments, and other organizations interested in implementing CCMP recommendations should actively pursue public/private and public/public partnerships to implement CCMP



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recommendations. The Delaware Estuary Foundation may assist in negotiations of partnerships in which it will not be a party. The CCMP recommendations that would lend themselves to public/private or public/public partnerships are:

- L1 Develop a Comprehensive Environmental Policy Plan for the Delaware Estuary
- L2 Support Watershed-Based Planning
- L4 Support the Establishment of Riparian Corridor Protection Programs
- L6 Identify and Support Greenspace Program Plans to Protect Natural Resource Areas Related to the Estuary
- L11 Establish a Land Use Planner Circuit Rider
- L17.1 Tri-State Redevelopment Forum

- W3 Conduct Modeling Studies for Tributary Watersheds Experiencing Stream Diminution Problems
- W5 Encourage the Reuse of Wastewater for Nonpotable Purposes
- W8.2 Maintain Access to High Use Recreational Areas
- W8.4 Develop a Long Term Management Plan for Dredged Material
- W9 Utilize RIMS for Information Management That Facilitate Port Operations
- W10 Support Private Sector Efforts in Oil Spill Response and Pollution Prevention

- H5 Target Habitat Enhancement Opportunities for Present and Future Action
- H7 Implement Measures to Protect Shoreline and Littoral Habitats that are Threatened by Sea Level Change
- H8 Facilitate Coordination among the States to Update and Improve Environmental Sensitivity Index Mapping for Hazardous Spill Response Information

- T1 Implement a Toxics Management Strategy
- T2.1 Public Education on Chemical Usage and Household Toxics Waste Collection
- T2.2 Implement Agricultural Pesticide Collection Program
- T2.3 Develop Education Program for Small Industries on Usage of Chemicals

- E1 Continue Existing Public Participation Program
- E2 Hold and Attend Public Meetings and Workshops
- E3 Continue Holding Annual Events
- E4 Support of Land Use Action Plan
- E5 Support of the Water Use Action Plan
- E6 Support of Habitat Action Plan
- E7 Support of Toxics Action Plan
- E8 Conduct and Publish Public Attitude Surveys
- E10 Promote Ecotourism
- E11 Encourage Citizen Monitoring
- E12 Promote "Hands-On" Activities

- E13 Support Floating Classrooms
- E14 Develop and Publish Outreach Articles
- E15 Meet Demand for Existing and New Publications
- E16 Utilize Electronic Bulletin Boards
- E17 Establish Estuary Resource Sections
- E18 Implement Storm Drain Stenciling
- E19 Incorporate Estuarine Education in Curricula/Support Challenge Grants
- E20 Develop and Place Permanent Displays
- E21 Develop an Estuary Mascot
- E22 Establish Delaware Estuary Merit Badge
- E23 Develop and Place Watershed Signs

- R2 Implement Expanded Regional Information Management Service

- M3 Establish Office of Monitoring and Mapping
- M4 Implement Minimal Monitoring Plan
- M5 Implement Expanded Monitoring Plan
- M6 Evaluate and Report Monitoring Information

V. FEES FOR SERVICES

Fees for services can be charged if there is a public demand for a service or if there is an identified group of individuals or organizations that are directly responsible for negative impacts on natural resources. Fees for services should only be implemented by agencies that have statutory taxing authority. An example of public demand for a service includes a need of a neighborhood to have its septic systems pumped out regularly. The local government can put together a package deal for the neighborhood and tax the residents for the service at a better rate than each homeowner can contract for the service individually. A stormwater utility, where a municipality taxes its residents for stormwater control, is an example of the latter type of service fee. These types of programs can also be funded through general obligation and revenue bonds.

The following is a list of fee for services programs that can be implemented at the local government level:

Aquifer Protection Districts - Main purpose is protection of subterranean water from pollution. Funds may be used for activities such as water protection planning, construction of stormwater facilities, monitoring and inspection of on-site septic systems, and implementation of groundwater management plans.

Betterments - A betterment is a project specific charge levied against individuals who receive some benefit from a public improvement separate from any benefit received by the community as a whole. Because betterments are project specific, they are limited to capital projects. Revenue sources include general obligation bonds to pay for the improvement and betterment revenue to cover



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the debt service. Betterment revenue is generally assessed and collected after the project has been completed.

Drainage Districts - This provides the authority to undertake stormwater management, including quantity and quality control. Revenue sources include special assessments and special assessment bonds.

Flood Control Zone Districts - Although mainly designed to control stormwater quality, flood control districts can also be used to address water quality issues. Revenue sources include special assessments, fees for service, tax revenues, and general obligation bonds.

Health Districts - The main use for funds raised by health district permit fees is the operation of on-site system maintenance and operation programs. Permit fees would be the revenue source.

Impact Fees - Funds can be used to cover the increase of public capital costs for new development, including sewer and water extensions, stormwater management improvements, and open space maintenance. Fee assessments would be the revenue source.

Lake Management Districts - Funds can be used for improvement and maintenance of lakes. Can include on-site system maintenance programs, stormwater management programs and other water quality protection activities, such as agricultural waste control. Revenue sources include rates and charges, revenue bonds, and special assessments.

Sewer/Water Districts - Can be used to fund construction, maintenance and operation of sewers, including on-site septic systems. This authorizes districts to become involved in any activity that improves water quality, including on-site system maintenance, nonpoint pollution control and wetlands preservation and restoration. Revenue sources include rates and charges, general obligation bonds, revenue bonds, and special assessments.

Shellfish Protection Districts - The purpose of these districts is to address nonpoint pollution threats to water quality and shellfish resources. Should include any element needed to deal with the pollution threat, including stormwater management, on-site system monitoring, inspection and repair, animal grazing and manure management, and education and public involvement activities. Revenue sources include rates and charges, tax revenues, and inspection fees.

Stormwater Utilities - Funds raised by stormwater utilities can be used for comprehensive stormwater management and on-site system maintenance and inspection programs. Revenue sources include rates and charges, general obligation bonds, revenue bonds, fines and penalties, and special assessments.

The CCMP recommendations that would lend themselves to fees for services are:

- L5 Implement Urban Best Management Practices
- L16.1 Regional Utilities for Small Wastewater Systems

- W8.2 Maintain Access to High Use Recreational Areas
- W9 Use RIMS for Information Management That Facilitate Port Operations
- W11.4 Establish a Stable Source of Funding for Future Public Access Facilities
- W12 Inventory Available Pump-Out Stations and Address Any Identified Deficiencies
- W13.3 Implement CSO Control Strategy

- T2.1 Public Education on Chemical Usage and Household Toxics Waste Collection
- T2.2 Implement Agricultural Pesticide Collection Program
- T2.3 Develop Education Program for Small Industries on Usage of Chemicals

- E13 Support Floating Classrooms
- E16 Utilize Electronic Bulletin Boards to Disseminate Information

- R2 Implement Expanded RIMS

VI. CHANGES TO CLEAN WATER ACT

A. CCMP Implementation Grants

It is the recommendation of the Financial Planning Committee that the Congressional delegation for the Delaware Estuary region should sponsor legislation that would provide grants to support CCMP implementation.

Section 320 of the Water Quality Act Amendments of 1987 only allows the Environmental Protection Agency to make grants for the development of Comprehensive Conservation and Management Plans for national estuaries. EPA does not have the authority to make grants to CCMP implementors after the plan is finished. The Clean Water Act should be amended to allow EPA grants to cover administrative costs of CCMP implementation.

B. Redirection of Penalties Collected by EPA

It is the recommendation of the Financial Planning Committee that all penalties collected by the U.S. Environmental Protection Agency for violations of the Clean Water Act that impact a national estuary be applied to the implementation of the respective estuary's Comprehensive Conservation and Management Plan.

Currently, most penalties collected for Clean Water Act violations are deposited in the U.S. general treasury, except for rare cases where special provisions are included in



the settlement papers. The Financial Planning Committee contends that if a nationally recognized estuary is damaged by a Clean Water Act violation, then it is in the national interest to use any penalties collected as a result of said violation to restore, preserve, and protect the estuary.

Re-assigning penalties from Clean Water Act violations from the federal treasury to national estuaries would allow the federal government to help ensure their investment in these estuaries without adding a new line item in the federal budget. The federal government is currently expending substantial funds and personnel resources on developing CCMPs for the 21 national estuaries. The cooperative working relationship that has been developed through the National Estuary Program between federal agencies and the people who live in national estuary basins is a unique relationship. It would seem even more important to maintain that relationship as the CCMP is being implemented than it was during CCMP development. Applying penalty receipts to CCMP implementation would be one way of maintaining the federal partnership without applying undue pressure on the federal budget. Receipts from penalties are not included in budget projections, therefore the allocation of these funds to a national estuary would not impact the federal budget.

C. Redirection of Penalties Collected by Delaware, New Jersey, and Pennsylvania

It is the recommendation of the Financial Planning Committee that a portion of the penalties collected by the States of Delaware and New Jersey and the Commonwealth of Pennsylvania for violations of the Clean Water Act that impact the Delaware Estuary be applied to the implementation of the Comprehensive Conservation and Management Plan for the Delaware Estuary.

Currently, all penalties collected for Clean Water Act violations by the three states are not specifically dedicated to improving the water body that was damaged during the violation. In Delaware [and New Jersey], these funds are allocated at the discretion of the Secretary of the Department of Natural Resources and Environmental Control, while New Jersey requires that these funds be used for clean water enforcement activities and grants to counties. In Pennsylvania, all Clean Water Act fines are placed in the Clean Water Fund that is administered by the Secretary of the Department of Environmental Resources and can only be used for water-related projects. The Financial Planning Committee contends that if a nationally recognized estuary is damaged by a Clean Water Act violation, then it is in the national interest to use a portion of any penalties collected as a result of said violation to restore, preserve, and protect the estuary. In special cases where the violation has interstate impacts or results in a large or re-occurring penalty, the states involved should consider establishing an environmental trust that is administered by the states for the purpose of supporting the implementation of the CCMP and the administrative costs of CCMP implementation.

Dedicating a portion of the penalties collected by the states from Clean Water Act violations to the Delaware Estuary would allow the state governments to help ensure their investment in the Delaware Estuary. The Governors of the three states signed an agreement to implement the Comprehensive Conservation and Management Plan for the Delaware Estuary. All three states already dedicate environmental penalties to environmental projects. The further limitation of a portion of Clean Water Act penalties to the Delaware Estuary would reinforce the commitment made by the Governors and help to foster continued tri-state coordination in the future management of the Delaware Estuary.

It is the recommendation of the Financial Planning Committee that violators of the Clean Water Act in the Delaware Estuary be encouraged to make a donation to the Delaware Estuary Foundation in lieu of a portion of the assessed penalty.

An alternative to having states dedicate a portion of all Clean Water Act penalties for violations in the Delaware Estuary is to have the violating party make a donation to the Delaware Estuary Foundation in lieu of a portion of the penalty. Because the States are members of the Delaware Estuary Foundation, they will be actively involved in the allocation of the funds by the Foundation. Making a donation directly to the Foundation will also avoid the need for the state to expend administrative resources in handling the funds. The administrative expenses related to contracting, grants management, and accounting would fall on the Foundation.

VII. DELAWARE RIVER AND BAY AUTHORITY'S ECONOMIC DEVELOPMENT PROJECTS

The Delaware River and Bay Authority was established by the States of Delaware and New Jersey to provide river and bay crossings between the two states. The Authority built and maintains the Delaware Memorial Bridge and the ferry service between Cape May, New Jersey, and Lewes, Delaware. In the late 1980s, the Authority reported that its receipts exceeded the cost of maintaining the river crossings and suggested that legislation be enacted to allow the Authority to use its funds for purposes other than river crossings. The State of New Jersey and the State of Delaware amended the Delaware-New Jersey Compact by empowering the Delaware River and Bay Authority to provide funding for commerce facilities and developments provided that such projects are in compliance with environmental laws.

As defined in the Compact:

"Commerce facility or development" means any structure or facility adapted for public use or any development for a public purpose within each of the States party hereto in connection with recreational and commercial fishery development, recreational marina development, aquaculture (marine farming), shoreline preservation and development (including wetlands and open-lands acquisition, active recreational and park development, beach restoration and development, dredge spoil disposal and port-oriented development), foreign trade zone site development, manufacturing and



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industrial facilities, and other facilities of commerce which, in the judgment of the Authority, are required for the sound economic development of the area.

The Delaware River and Bay Authority has further limited the use of these funds in the following manner:

- * Limit transportation investments to projects that earn enough money to break even on operating costs, cover debt payments, and produce jobs.
- * Require at least 50 jobs for every \$500,000 invested in "commerce" development projects not directly tied to transportation.
- * Cap nontransportation commerce investment at 20 percent of the authority's net general fund balance.

Based on the above definition and DRBA imposed limitations:

It is the recommendation of the Financial Planning Committee that the States of Delaware and New Jersey should request that the Authority fund the following CCMP recommendations:

- L6 Identify and Support Greenspace Program Plans to Protect Natural Areas Related to the Estuary
- W9 Utilize RIMS for Information Management That Facilitate Port Operations
- W10 Support Private Sector Efforts in Oil Spill Response and Pollution Prevention
- W11.4 Establish a Stable Source of Funding for Future Public Access Facilities
- W12 Inventory Available Pump-Out Stations and Address Any Identified Deficiencies
- H5 Target Habitat Enhancement Opportunities for Present and Future Action
- H7 Implement Measures to Protect Shoreline and Littoral Habitats that are Threatened by Sea Level Change
- E10 Promote Ecotourism
- E12 Promote "Hands-On" Activities
- E13 Support Floating Classrooms
- E20 Develop and Place Permanent Displays
- E23 Develop and Place Watershed Signs

VIII. SUMMARY

The Delaware Estuary Financial Plan includes twenty-one different funding options. The thirteen options identified to support the Delaware Estuary Foundation have a potential of raising \$900,000 annually for the first 3 years plus an unidentifiable amount raised from license plate sales, partnerships with regional authorities, development opportunities, merchandising partnerships, private foundations, endowments, and court directed penalties. One or more funding options have been identified for each of the CCMP's recommendations. Redirection of current programs can fund the implementation of 138 (100%) of the CCMP's recommendations, partnerships 46 (33%), fees for services 13 (9%), and DRBA's Economic Development Projects 12 (8%). CCMP implementation grants and the redirection of penalties collected by EPA and the states will provide further funds. Some of the CCMP's recommendations may also be implemented through reallocation of staff time at various federal, state, and local agencies while still others may be completed by volunteers working with the Delaware Estuary Foundation and other nonprofit organizations.

Although funding the implementation of the CCMP according to this plan will require extensive coordination among several players and may require 10 + years before each CCMP recommendation is funded, this plan will implement the CCMP without requesting that a new general tax be applied to all the residents of the Delaware Estuary region.



DRAFT CCMP
